THE BATHONIAN UPPER ESTUARINE SERIES OF EASTERN ENGLAND

PART I: OSTRACODA

BY

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Pp. 21–66; 22 *Plates*; 1 *Text-figure*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY Vol. 14 No. 2
LONDON: 1967

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 *a separate supplementary series of longer papers was instituted, numbered serially for each Department.*

This paper is Vol. 14, No. 2 of the Geological (Palaeontological) series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.

World List abbreviation: *Bull. Br. Mus. nat. Hist. Geology.*

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 8 *February*, 1967 *Price* £3 10s.

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PART I: OSTRACODA

By R. H. BATE

CONTENTS

SYNOPSIS

Twenty-nine species of Ostracoda, of which 18 are new, are described from the Bathonian Upper Estuarine Series of Eastern England. Of this ostracod fauna two genera, *Belekocytheridea* and *Platycythere*, and two subgenera, *Eoschuleridea* and *Mediodentina* are new. A palaeoecological study of the ostracod faunas indicates an alternation throughout the succession of marine and freshwater conditions. Of the two new genera, *Belekocytheridea* inhabits a brackish water environment and *Platycythere* a marine to brackish water environment. Of the two new subgenera, *Eoschuleridea* is marine whilst *Mediodentina* is euryhaline, ranging from marine through brackish to almost freshwater conditions.

FIG. 1. Outcrop of Middle and Upper Jurassic Rocks in Eastern and Northeastern England with localities sampled within the Upper Estuarine Series shown.

I. INTRODUCTION AND ACKNOWLEDGMENTS

Stretching from North Lincolnshire to the borders of Oxfordshire is a narrow strip of marine and freshwater clays, with some thin limestones, showing evidence of deposition in shallow water. These beds, known as the Upper Estuarine Series, underlie the rubbly limestones of the Bathonian Great Oolite Limestone and with a marked unconformity overlie the Bajocian Lincolnshire Limestone. They form the basal Bathonian sediments in the area.

The absence of ammonites from the Upper Estuarine Series makes the dating of these sediments rather difficult. However, mapping and the examination of the invertebrate faunas suggests that they may be equivalent to the Hampen Marly Beds of further south. Certainly the ostracod faunas would not, at this stage, disagree with this. If this correlation is to be regarded as correct, the Upper Estuarine Series would be Middle Bathonian in age and belong to the zone of *Tulites subcontractus* (Morris & Lycett).

Although of shallow water origin, there is evidence to suggest that these beds are not estuarine deposits in the strictest sense. Dr. C. J. Aslin of the University of East Anglia has for some time now been working on the stratigraphical and sedimentological problems of the Upper Estuarine Series, and it was he who made available his large collection of ostracods which form the basis of the present paper.

The sections from which the ostracods were obtained occur in large quarries where the Upper Estuarine Series represents the overburden. The continual cutting back of these sediments makes it impossible to maintain a permanent section. The quarries are located as follows (see Text-fig. 1):

Kings Cliffe—TL/012966.
Ancaster (Thompson's Pit)—SK/992409.
Ketton (Portland Cement Quarry)—SK/972057–9.
Cranford St. John (Kettering)—SP/926764.
Dane Hill—SP/465273.

It should be noted that in some cases the quarries are sited a mile or so from the town whose name they bear.

The morphological terms used in the present paper are taken from Sylvester-Bradley (1956), Moore (1961) and Bate (1963). All the ostracods described in the text have been deposited in the collections of the Palaeontology Department, British Museum (Natural History).

I should like to record my grateful thanks to Dr. H. J. Oertli, S.N.P.A., Pau, France, and to Dr. H. Malz, Senckenberg Museum, Frankfurt, Germany, for the loan of material which proved invaluable for comparison with the present fauna. Mr. S. H. Eagar printed the photographs originally taken by myself.

II. SYSTEMATIC DESCRIPTIONS

The beds from which the ostracods were obtained are identified by a letter and refer to beds described by Aslin (in press).

Order PODOCOPIDA Müller 1894

Suborder PODOCOPINA Sars 1866

Superfamily **CYPRIDACEA** Baird 1845

Family **PARACYPRIDIDAE** Sars 1923

Genus ***PARACYPRIS*** Sars 1866

Paracypris terraefullonica (Jones & Sherborn)

(Pl. 1, figs 1–6)

1888 *Macrocypris terrae-fullonicae* Jones & Sherborn : 252, pl. 5, figs. 3*a–c*.
1888 *Macrocypris horatiana* Jones & Sherborn : 252, pl. 5, figs. 2*a–c*.

Diagnosis. *Paracypris* with elongate carapace, posteriorly acuminate. Anterior rounded. Ventral margin almost straight in the larger left valve, more strongly concave in right. Dorsal margin arched with antero-dorsal slope tending to be slightly concave, more noticeably so in right valve. Shell surface smooth. Anterior and posterior vestibules well developed. Radial pore canals branching.

Lectotype. Selected here, I.1875, left valve, from the Blue Fullers-earth clay; Midford near Bath, figured Jones & Sherborn 1888, pl. 5, figs. 3*a–c*.

Other material. I.1874, right valve, from the Blue Fullers-earth clay; Midford near Bath, figured Jones & Sherborn 1888, pl. 5. figs. 2*a–c*. Io.2250–58, from the Upper Estuarine Series, beds M, R & S, Kings Cliffe; base of bed H: Ketton and bed I, Kettering.

Description. **Carapace** elongate, subreniform, rounded anteriorly, acuminate posteriorly. Dorsal margin arched, convex in the right valve, almost straight, sloping posteriorly in the left. Cardinal angles rounded. Antero-dorsal slope tends to be slightly concave, particularly just behind the anterior margin, a situation more noticeable in the right valve. Ventral margin almost straight in the left valve, concave medially in the right. Greatest height of carapace in anterior third in the left valve, almost median in the right. Greatest length below mid-point; greatest width median. Shell surface smooth. Left valve larger than the right which it overlaps along the ventral, postero-dorsal and antero-dorsal slopes. Posteriorly the left valve slightly over-reaches the right whilst anteriorly the right valve over-reaches the left. **Hinge** consists of a simple groove in the left valve into which the dorsal edge of the right valve fits. **Inner margin** and **line of concrescence** do not coincide terminally, prominent **vestibules** being produced. Anteriorly the vestibule is broad whilst posteriorly more narrow, extending along the postero-ventral margin of the inner part of the valve up to the centre of the median incurvature. **Radial pore canals** not clearly observed, but appear to be few in number and antero-ventrally can be seen to be branching. Three centrally situated oval **muscle scars** can be distinguished in the lectotype with a fourth situated behind.

DIMENSIONS. Lectotype. I.1875, left valve, length 0·60 mm., height 0·28 mm. Other material. I.1874, right valve, length 0·58 mm., height 0·26 mm. Io.2250, carapace, length 0·65 mm., height 0·31 mm., width 0·27 mm. Io.2251, right valve length 0·65 mm., height 0·31 mm. Io.2255, right valve, length 0·65 mm., height 0·31 mm. Io.2256, carapace, length 0·60 mm., height 0·29 mm., width 0·24 mm. Io. 2257, right valve, length 0·61 mm., height 0·27 mm.

REMARKS. *Paracypris terraefullonica* was originally described by Jones & Sherborn (1888 : 252) as *Macrocypris terrae-fullonicae*. Also described in the same publication is the ostracod *M. horatiana* which occupies a position within the publication previous to that of *M. terrae-fullonicae*. Both these species are considered to be synonymous. The decision to select *M. terrae-fullonicae* as the type was influenced by the better preservation of the specimen available and the preference in name, indicating as it does, derivation from the Bathonian Fullers-Earth.

Paracypris terraefullonica is similar to *Paracypris*? sp. *A*. Schmidt (1955 : 52) but differs posteriorly. In *P.*? sp. *A*. the posterior margin is close to the posterior cardinal angle, whilst that part of the valve behind the cardinal angle is more elongate. *P. bajociana* Bate (1963 : 186, pl. 2, figs. 1–8) has a much longer and more straight dorsal margin.

Superfamily **DARWINULACEA** Brady & Norman 1889

Family **DARWINULIDAE** Brady & Norman 1889

Genus ***DARWINULA*** Brady & Robertson 1885

REMARKS. *Darwinula stevensoni*, the type species, has the right valve larger than the left, a feature given as characteristic of the genus in the Treatise on Invertebrate Paleontology (Moore 1961 : 254). Several species of *Darwinula* are known, however, to possess a carapace in which the left valve is the larger. For example, the Recent *D. daps* Harding (1962 : 60, figs. 45–53) and the Purbeckian *D. leguminella* (Forbes *in* Lyell 1855 : 294, text-fig. 334*c*). Many more species are so described in the literature. *D. incurva* sp. nov., described below also possesses a carapace in which the left valve is the larger.

Darwinula incurva sp. nov.

(Pl. 1, figs. 7–12)

1965 *Darwinula* sp.A. Bate : 751, pl. 109, figs. 1–4.

DIAGNOSIS. *Darwinula* of large size with broadly arched dorsum, rounded anterior and posterior, and strongly incurved ventral margin anterior of valve centre. Left valve strongly overlaping right along ventral margin and around posterior. Anteriorly left valve over-reaching right. Shell surface finely punctate. Muscle scars as for family.

HOLOTYPE. Io.2259, a complete carapace from bed Q Kings Cliffe.

PARATYPES. Io.2260–74, from bed Q Kings Cliffe, and beds O & R Ancaster.

DESCRIPTION. **Carapace** oval-elongate, very finely punctate, appearing smooth in most specimens, although the internal surface of the valves is quite strongly punctate. Greatest length passes either through or just below mid-point, being dependent upon the outline of the anterior margin which may be either broadly rounded or extended forward slightly below mid-length. Posterior broadly rounded with the greatest width situated in the posterior third. Greatest height median. Dorsal margin arched. Ventral margin convex in the posterior half, strongly and characteristically incurved antero-medially. Left valve larger than the right which it strongly overlaps around the posterior and along the ventral margin. Around the anterior the overlap is replaced by overreach though along the antero-and postero-dorsal slopes overlap of the right valve by the left is noticeable. **Muscle scars** typical of the genus, consisting of a rosette of scars which in one specimen is composed of eleven in number. **Inner margin** and **line of concrescence** coincide anteriorly (not seen posteriorly) where a narrow **duplicature** is present. The surface of the duplicature in the left valve is serrated at right angles to the inner margin. The purpose of this is conjecture at the moment. Anterior **radial pore canals** short, straight and evenly spaced, about 20 in number. A long, narrow groove extends along the dorsal margin of the right valve, into which the dorsal margin of the left valve fits for purposes of articulation.

DIMENSIONS. Holotype. Io.2259, carapace, length 1·03 mm.; height 0·43 mm.; width 0·37 mm.

Paratypes. Io.2260, carapace, length 1·03 mm.; height 0·48 mm.; width 0·40 mm. Io.2261, left valve, length 0·83 mm.; height 0·37 mm.

REMARKS. *Darwinula* sp. *A*. Bate 1965 is a juvenile instar of the present species and is here placed into synonymy. Comparison with other British Mesozoic darwinulids shows *D. incurva* to be larger, more elongate and more strongly incurved than previously described species. *D. incurva* is similar in outline to *D. tubiformis* Ljubimova (1956 : 119, pl. 23, figs. 1*a–b*.) from the Lower Cretaceous of Mongolia but differs in not being so strongly swollen posteriorly and in being more slender in dorsal view. *D. barabinskensis* Mandelstam (as figured in Ljubimova 1960 : 28, pl. 2, fig. 2) from the Lower Cretaceous of the western Siberian Lowlands (Krasnoyarsk region) is close to *D. incurva* in dorsal outline but does not taper quite so much anteriorly neither is it as incurved antero-ventrally.

Superfamily **CYTHERACEA** Baird 1850

Family **LIMNOCYTHERIDAE** Klie 1938

Subfamily **TIMIRIASEVIINAE** Mandelstam 1960

Genus ***BISULCOCYPRIS*** Pinto & Sanguinetti 1958

REMARKS. As stated elsewhere (Bate 1965) difference of opinion exists relating

to the validity of the two genera *Bisulcocypris* and *Theriosynoecum*. Sylvester-Bradley & Pinto (MS.) are currently of the opinion that within the Timiriaseviinae there are two distinct genera, one with hollow tubercles (*Theriosynoecum*), the other with or without solid tubercles (*Bisulcocypris*). An opinion with which I am in full agreement.

The presence of tubercles amongst these fresh to brackish water ostracods would appear to be either a genotypic or a phenotypic character. In those species which are normally without such ornamentation but which occasionally show it—it is conceivable that the presence of tubercles is in some way controlled by the environment (pH, salinity etc.) and as such would be a phenotypic character. There appears to be a definite division between those species which show this possible phenotypic variation and those in which the tubercles are genotypically controlled. The genus *Theriosynoecum* is considered to fall into the latter category, whilst in *Bisulcocypris* both phenotypic and genotypic tuberculate species occur. A genotypic species is one in which tubercles are present through all the ontogenetic stages, whilst a phenotypic species only shows the development of tubercles or nodes in the adult stage, and then, as appears to be often the case, in only one dimorph. In *B. anglica* sp. nov., for example, the nodes are characteristically developed in the male dimorph only.

Bisulcocypris anglica sp. nov.

(Pl. 2, figs. 1–11)

1965 *Bisulcocypris* sp. *A.*, Bate : 753, pl. 109, figs. 13, 14.

Diagnosis. *Bisulcocypris*, oval/elongate in side view, tapering slightly to anterior. Posterior tapered in female dimorph. Greatest height at posterior cardinal angle. Ventro-lateral margin strongly convex, overhanging ventral surface. Two, short, crescentic sulci extend down from dorsal margin in anterior half of valve. Shell surface laterally punctate to reticulate. Ventro-lateral and ventral surfaces with strong lateral ridges. Slender males may possess small nodes in posterior half; females without nodes. Female with characteristic narrow posterior, produced by steeply sloping posterodorsal margin of posterior swelling. Male tending to have broader (height) posterior. Hinge lophodont. Valves equivalve.

Holotype. Io.2275, female carapace from bed Q, Kings Cliffe.

Paratypes. Io.2276–99. Locality as above.

Description. **Carapace** oval/elongate with the greatest height being in the posterior half at the posterior cardinal angle in adults but is situated at the anterior cardinal angle in juveniles. Greatest length through or slightly below mid-point. Greatest width in the posterior half in female dimorphs, median in the male. Posterior broadly rounded in the male dimorph whilst in the posteriorly swollen female the posterior becomes much narrower (height) due to the steeply sloping dorsal surface of the posterior swelling. Posterior cardinal angle sharply angled in both sexes, anterior cardinal angle shallow, broadly rounded sweeping down to the

narrowing anterior margin. Dorsal margin medially concave in the female dimorph, but less noticeably so in the male. Ventro-lateral margin strongly convex, overhanging the ventral surface. Shell surface strongly punctate to reticulate. Prominent lateral ridges extend along the ventro-lateral and ventral surfaces. In the male dimorph a number of small nodes (usually two in number) may occur in the posterior half of the carapace. One node is positioned just below and behind valve centre with the second node a short distance below and in front of this. In a single male, two smaller nodes occur dorsal to these. Two very small nodes are situated at the extreme posterior and a number around the anterior margin of both sexes. These are the only ones which occur in the female. Occasionally the median node described for the male is found also in a juvenile instar. Juveniles tend to be rather square in outline. Two, shallow, rather concentric sulci extend for a short distance only from the dorsal margin. Both sulci are situated in the anterior half of the carapace. Both left and right valves are of equal size. Along the ventral margin there is no overlap; postero-ventrally the right valve over-reaches the left whilst at the position of the antero-median incurvature the left over-reaches the right. Along the antero-dorsal slope the left valve progressively over-reaches the right with the maximum over-reach being at the anterior cardinal angle. Behind this angle the right valve strongly over-reaches the left for a short distance. Very slight overlap of the right by the left occurs at the posterior cardinal angle. **Muscle scars** are situated low down on the lateral part of the carapace below the first more medially situated sulcus, and consist of a backwardly sloping row of four adductor scars. Muscle scars anterior to these have not been observed. **Hinge** lophodont, only observed in the right valve where the median groove is long and rather broad. The anterior tooth is large and blade-like, being an enlarged, flattened continuation of the **selvage**. Posterior tooth not seen. From the dorsal view of a complete carapace it is obvious that an accommodation groove is present in the posterior half of the left valve. Around the anterior the **inner margin** and **line of concrescence** do not quite coincide. The separation is not really sufficient, however, for a **vestibule** to be developed. Anterior **radial pore canals** long and straight extending into the broad anterior **flange**, approximately 20 in number.

Dimensions. Holotype. Io.2275, female carapace, length 1·00 mm.; height 0·58 mm.; width 0·58 mm.

Paratypes. Io.2277, male carapace, length 1·04 mm.; height 0·63 mm.; width 0·51 mm. Io.2278, male carapace, length 0·98 mm.; height 0·56 mm.; width 0·47 mm. Io.2279, female carapace, length (broken) 0·98 mm.; height 0·66 mm.; width 0·68 mm. Io.2280, juvenile carapace, length 0·61 mm.; height 0·35 mm.; width 0·28 mm.

Remarks. The development of nodes in this species is restricted in adults to the male dimorphs and to a number of juvenile instars. Possibly those juveniles which show this feature may have been immature males, although there is no way of confirming this. *Bisulcocypris anglica* is close to *B. tenuimarginata* (Oertli 1957 : 765, pl. 23, figs. 15–24), specimens of which were kindly sent to me by Dr. Oertli, but is a much larger more elongate species. The anterior half of *B.*

tenuimarginata is quite short and stubby when compared with the elongate anterior of *B. anglica*. The French species does not appear to show any tendency towards the development of lateral nodes. *Bisulcocypris* sp. *A*. described from the Bathonian of Oxfordshire is considered to belong to this species.

Bisulcocypris ancasterensis sp. nov.

(Pl. 3, figs. 1–10)

1965 *Bisulcocypris* sp. *B* ; Bate : 753, pl. 109, figs. 10–12.

Diagnosis. *Bisulcocypris* rectangular in outline with height at anterior cardinal angle almost equal to that at posterior cardinal angle. Strongly bi-sulcate, dimorphic. Shell surface punctate/reticulate with three nodes in posterior half and two nodes in anterior half. Smaller additional nodes occur at extreme posterior and anterior. Both nodes and surface ornamentation more positively developed in juvenile instars. Muscle scars as for genus.

Holotype. Io.2282, female carapace from bed R, Ancaster.

Paratypes. Io.2283–5, 2300–1, from bed R, Ancaster.

Description. **Carapace** rectangular, dimorphic, rounded anteriorly and posteriorly. Dorsal and ventral margins in the male dimorph are almost parallel with only a shallow concavity medially. In the female, identified by the swollen posterior half, the dorsal margin is quite strongly concave medially. Ventro-lateral margin in both dimorphs overhangs the ventral surface as viewed laterally. Greatest length through mid-point with greatest height and width in posterior half in males and females; greatest height in anterior half in juveniles. Carapace in the anterior half bi-sulcate, the posterior sulcus being the better developed of the two; this is especially true in the female dimorph. The adductor **muscle scars** which consist of an oblique row of four scars, are situated at the base of this sulcus. Cardinal angles distinct. Shell surface punctate to reticulate, further ornamented by a number of prominent nodes. In the posterior half of the carapace three nodes are arranged in a triangular pattern; a large central node with one of equal size situated in front and below this and a smaller node situated behind and below. Smaller nodes may occur above these and on the posterior. In the anterior half two nodes are present; one in front of the ventro-lateral termination of the posterior sulcus and the second, much higher up, in front of the termination of the anterior sulcus. Ventral surface ornamented with low, longitudinal ridges. Left valve larger than the right, which it overlaps along the ventral margin, especially mid-ventrally, and again at the anterior and posterior cardinal angles. There is no terminal overlap. Mid-dorsally the right valve over-reaches the left. Juvenile instars reticulate with well developed nodes. Posteriorly the two low nodes which occur dorsally above the main group of three in the adults are here strongly developed and are equal in dominance to the others. Internal details have not been observed in the present material but have been described for *B.* sp. *B.* (see Bate; 1965 : 754).

DIMENSIONS. Holotype. Io.2282, female carapace, length 0·91 mm.; height 0·55 mm.; width 0·51 mm.

Paratypes. Io.2284, male carapace, length 0·98 mm.; height 0·51 mm.; width 0·36 mm. Io.2285, juvenile carapace, length 0·61 mm.; height 0·35 mm.; width 0·21 mm.

REMARKS. *Bisulcocypris ancasterensis* sp. nov., in being strongly nodose differs at once from *B. anglica* sp. nov., and *B. tenuimarginata* (Oertli). Moreover, it may also be distinguished from the above in outline (having a much deeper anterior than found in *B. anglica* and a much more elongate anterior half than that occurring in *B. tenuimarginata*) and by the more strongly developed second sulcus, never developed to such an extent in the other two species. *Bisulcocypris* sp. *B.* described from the Bathonian of Oxfordshire is almost certainly conspecific with the present species, despite its larger size.

Family **BYTHOCYTHERIDAE** Sars 1926

Genus ***MONOCERATINA*** Roth 1928

Monoceratina scarboroughensis Bate

(Pl. 3, fig. 11)

1965 *Monoceratina scarboroughensis* Bate : 99, pl. 1, figs. 1–12.

REMARKS. A single female carapace, of good preservation has been found in bed B in the Kettering section. The range of this species is thus extended from the Bajocian (*blagdeni* in part) into the Bathonian, although here again correlation of the horizons with known ammonite zones has not been possible.

Family **CYTHERIDEIDAE** Sars 1925

Subfamily **CYTHERIDEINAE** Sars 1925

Genus ***FABANELLA*** Martin 1961

REMARKS. Although placed by Martin into the Cytheridae, *Fabanella* is here considered to be more closely allied to the Cytherideidae on account of the shape and structure of the carapace, simple pore canals and muscle scar pattern. Although the antennal scar is not so strongly U-shaped as for the nominal genus Martin's illustration (pl. 1, fig. 5*b*) for the type species indicates that the arrangement is the same and belongs to Type **B** (Bate 1963 : 181, figs. 8–10).

Fabanella bathonica (Oertli)

(Pl. 4, figs. 1–5)

1957 *Cyprideis? bathonica* Oertli : 758, pl. 21, figs. 12–20, pl. 22, figs. 1–6, 11, 12, (*Non.* figs. 7, 8, ? figs. 9, 10).
1963 *Fabanella bathonica* (Oertli) Oertli, pl. 28 (2), fig. *m*.

Material. Specimens registered in the collections: Io.2303–15 from bed R, Kings Cliffe and bed U, Ancaster.

Remarks. *Fabanella bathonica* does not occur generally throughout the Upper Estuarine Series, being restricted to only a few horizons. However, when it does occur it is a common species amongst a marine to brackish-water fauna. Specimens of this species were kindly sent to me for comparison purposes by Dr. Oertli.

Subfamily **GALLIAECYTHERIDEINAE** Andreev & Mandelstam 1964

Remarks. The subfamily Galliaecytherideinae introduced by Andreev & Mandelstam contains genera which although possessing some external resemblance to those placed in the Schulerideidae are nevertheless distinguished by their possession of a type A muscle scar pattern and simple radial pore canals. The genus *Galliaecytheidea* Oertli (1957 : 654) was placed into the Schulerideidae in error by Bate (1963 : 207), a situation which is here corrected.

Andreev & Mandelstam include within their new subfamily the following genera: *Galliaecytheridea* Oertli, *Lyubimovina* Neale, *Palaeocytheridella* Mandelstam, *Asciocythere* Swain, *Rubracea* Mandelstam and *Procytheridea* Peterson. In the present paper, however, *Asciocythere*, *Procytheridea* and *Rubracea* are not considered to belong here. *Belekocytheridea* gen.nov. and *Pichottia* Oertli are considered to belong to this subfamily. Van Morkhoven (1963 : 307) considers the genus *Palaeocytheridella* Mandelstam to be a junior synonym of *Vernoniella* Oertli.

Subfamily **GALLIAECYTHERIDEINAE** Andreev & Mandelstam 1964

Genus ***GALLIAECYTHERIDEA*** Oertli 1957

Galliaecytheridea*? *kingscliffensis sp. nov.

(Pl. 4, figs. 6–12; Pl. 5, figs. 1–8)

Diagnosis. *Galliaecytheridea?*, dimorphic: females plump, subquadrate with backwardly sloping dorsal margin and concave postero-dorsal margin, producing short, upturned posterior. Males elongate. Both sexes with compressed anterior marginal border. Shell surface very finely punctate. Hinge entomodont. Muscle scars type A. Radial pore canals, straight, widely spaced; 9 anteriorly; 4 posteriorly.

Holotype. Io.2316, female carapace, bed S, Kings Cliffe.

Paratypes. Io.2317–27, beds J & S, Kings Cliffe and bed W, Ancaster.

Description. **Carapace** plump and subquadrate in outline with triangular-shaped posterior, slightly upturned, in the female dimorph. Males more elongate

in outline but otherwise similar. Greatest length of the carapace passes through mid-point and the greatest height in the anterior half; through the anterior cardinal angle in the female but just behind this in the male. Greatest width median. In dorsal view the carapace is noticeably convex, especially in the female, with compressed anterior and posterior marginal borders. Dorsal margin straight or very slightly convex, sloping to the posterior, again more noticeably so in the female. Cardinal angles prominent. Anterior broadly rounded; posterior broadly triangular with a concave postero-dorsal slope producing a slight upturning. Ventral margin medially incurved, obscured in a whole carapace by the median convexity of the ventro-lateral margin. Shell surface very finely punctate with small, widely scattered, circular **normal pore canal** openings. There is no definite **eye swelling**, although a short, diagonal furrow, as found in such genera as *Praeschuleridea* and *Schuleridea*, occurs below the anterior cardinal angle. Here, however the groove may be seen in both valves. In the previously mentioned genera it is generally a feature of the right valve only. Left valve larger than the right which it overlaps along the ventral margin and over-reaches along the antero-, and postero-dorsal and dorsal margins. Terminally there is neither overlap nor over-reach. **Hinge** entomodont: left valve with terminal, elongate, loculate sockets separated by a strong median bar which is dentate along its length. The denticles of the median bar are very much enlarged in the anterior section. Above the median element a broad, deep, accommodation groove is developed. In the right valve there are six posterior teeth and probably a similar number anteriorly although damaged in the present material. The median groove which is loculate is expanded considerably in its anterior section. **Muscle scars** consist of a vertical row of four oval adductor scars with a single, round antero-dorsal antennal scar which is situated opposite the top two adductor scars. Mandibular scar crescent-shaped and antero-ventral in position. This muscle scar pattern thus falls into type **A**. **Inner margin** and **line of concrescence** coincide, producing a **duplicature** of moderate width. **Radial pore canals** straight and widely spaced, nine anteriorly and approximately four posteriorly. In single valves, the incurved part of the ventral margin can be seen to be obscured ventrally by a flattened " lip " convex downwards.

Dimensions. Holotype. Io.2316, female carapace, length 0·62 mm.; height 0·45 mm.; width 0·36 mm.

Paratypes. Io.2317, female carapace, length 0·64 mm.; height 0·44 mm.; width 0·35 mm. Io.2318, male carapace, length 0·71 mm.; height 0·43 mm.; width 0·35 mm. Io.2321, female left valve, length 0·64 mm.; height 0·45 mm. Io.2322, male left valve, length 0·69 mm.; height 0·43 mm. Io.2326, female right valve, length 0·58 mm.; height 0·36 mm.

Remarks. *Galliaecytheridea? kingscliffensis* sp. nov. is placed into the genus with a query owing to the fact that the hinge, in being entomodont, is quite unlike that found in any other species of this genus. It is not proposed to erect a subgenus to contain this species at this stage. The dimorphism found here is more clearly apparent than in other members of the genus. In fact the male dimorphs bear some resemblance to *Galliaecytheridea postrotunda* Oertli (1957 : 656, pl. 2, figs. 45–55)

although they do not taper so noticeably towards the posterior nor do they possess a posterior spine. The female dimorphs on the other hand are close to *G. dissimilis* Oertli (1957 : 655, pl. 1, figs. 32–49, pl. 2, figs. 40–44) from which they may be distinguished by their greater convexity (in dorsal view), dorsal margin with a slightly more pronounced slope to the posterior and by the presence of an entomodont hinge.

Genus ***BELEKOCYTHERIDEA*** nov.

TYPE SPECIES. *Belekocytheridea punctata* sp. nov.

DIAGNOSIS. Galliaecytherideinae with bean-shaped carapace; straight, somewhat flattened dorsal margin; antero-ventral and postero-ventral margins characteristically convex, projecting slightly below line of ventral surface. Antero-dorsal slope short, passing into uniformly rounded anterior. Postero-dorsal slope long, slightly convex. Cardinal angles prominent. Posterior narrowly rounded with greatest length passing below mid-point. Left valve larger than right. Hinge antimerodont; accommodation groove poorly developed. Inner margin and line of concrescence coincide. Radial pore canals straight, widely spaced, approximately 9 anteriorly and 5 posteriorly. Muscle scars a vertical row of 4 oval adductors with antero-dorsal antennal scar and antero-ventral mandibular scar (Type **A**).

REMARKS. The genus *Belekocytheridea* may be distinguished from all other ostracods by its characteristic, rather angular bean shaped carapace. At the present time only the type species has been definitely placed into the genus although a small number of specimens of a much larger species have been found within the Bajocian Upper Lincolnshire Limestone. These will be considered in a separate publication. The ecology of the type species suggests that the genus may be marine to brackish water in habit. In this it resembles *Lycopterocypris* Mandelstam 1956, a genus having a similar external appearance but internally distinguished by the presence of an Adont hinge.

Belekocytheridea punctata sp. nov.

(Pl. 5, figs. 9–13, Pl. 6, figs. 1–5)

DIAGNOSIS. *Belekocytheridea* with ventral and ventro-lateral surfaces ornamented by fine, longitudinal striae which terminally pass up onto lateral surface of carapace to parallel anterior and posterior margins. Terminally striae poorly developed, dying out before reaching dorsal margin. Remainder of lateral surface punctate. Species dimorphic. Hinge and muscle scars as for genus.

HOLOTYPE. Io.2328, female carapace, bed H, Ketton.

PARATYPES. Io.2329–57, male and female carapaces and single valves, bed H, Ketton; bed R, Ancaster and bed G, Kings Cliffe.

DESCRIPTION. **Carapace** bean shaped, convex in dorsal view, with prominent

cardinal angles when viewed laterally. Dorsal margin straight, very slightly convex. Antero-dorsal slope short passing into rounded anterior margin. Postero-dorsal slope long, slightly convex and passing into narrowly rounded posterior. Ventral margin incurved medially, overhung laterally by the convex ventro-lateral margin. Terminally the convex antero-ventral and postero-ventral margins project slightly below the ventral surface. Sexual dimorphism strongly apparent, the presumed males being very much more elongate but otherwise morphologically similar to the shorter female dimorphs. Greatest length of carapace occurs below mid-point whilst greatest height occurs at the posterior cardinal angle and greatest width through mid-point. Shell surface punctate laterally; terminally with weak striae paralleling the margins, the striae extending on to the lateral surface from the ventral surface. **Normal pore canal** openings circular, prominently developed and well spaced over the lateral surface. Left valve larger than the right which it overlaps along the ventral margin and strongly along the antero-, and postero-dorsal slopes. Terminally and dorsally there is no overlap. **Hinge** antimerodont; left valve with elongate terminal loculate sockets and a denticulate median bar. Accommodation groove virtually absent. Right valve with approximately 5–6 terminal teeth and an elongate locellate median bar. **Inner margin** and **line of concrescence** coincide, **duplicature** being of moderate width. A narrow **flange** extends around the anterior margin. **Radial pore canals** long and straight, widely spaced; 9 anteriorly and 5 posteriorly. **Muscle scars** (Type A) with the 4 adductors in a vertical row, the large rounded antennal scar being antero-dorsal in position. Mandibular scar antero-ventral.

Dimensions. Holotype. Io.2328, female carapace, length 0·57 mm.; height 0·31 mm.; width 0·29 mm.

Paratypes. Io.2329, male carapace, length 0·66 mm.; height 0·33 mm.; width 0·29 mm. Io.2331, female carapace, length 0·54 mm.; height 0·30 mm.; width 0·27 mm. Io.2356, male left valve, length 0·68 mm.; height 0·38 mm.

Remarks. *Belekocytheridea punctata* sp. nov., is quite unlike any previously described species and has, therefore, been placed into a new genus. The specimens, already referred to, as occurring in the Upper Lincolnshire Limestone are quite smooth whilst the present species has a partial ornamentation of longitudinal striae.

Genus *PICHOTTIA* Oertli 1959

Remarks. In the original diagnosis of *Pichottia* by Oertli (1959 : 115), size was considered to be a diagnostic character. This was based upon the very small size of the type species where the length of the female was in the order of 0·37–0·41 mm.; and that of the male 0·43–0·47 mm. In *Pichottia magnamuris* sp. nov., described below, the length of the female dimorph is in the region of 0·61–0·69 mm.; and that of the male 0·68–0·76 mm. A small size should not, therefore, be considered to be diagnostic of this genus.

Pichottia magnamuris sp. nov.

(Pl. 6, figs. 6–14, Pl. 7, figs. 1–6)

Diagnosis. *Pichottia*, plump, strongly convex in dorsal view, oval in lateral view. Dimorphic. Shell surface very finely punctate. Females of length 0·61–0·69 mm.; males of length 0·68–0·76 mm.

Holotype. Io.2358, female carapace, bed S, Kings Cliffe.

Paratypes. Io.2359–68, male and female carapaces and single valves from bed S, Kings Cliffe and Dane Hill.

Description. **Carapace** plump, strongly convex in dorsal view, the valves parting slightly at extreme anterior. Ovoid in lateral view tapering to the narrowly rounded posterior. Male dimorphs more elongate than the females, more strongly tapering posteriorly and not so convex in dorsal view. Anterior rounded with long, convex antero-dorsal slope; short convex dorsal margin and long postero-dorsal slope, strongly convex in the female, long and steeply sloping in the male. Posterior narrowly rounded. Ventro-lateral margin convex, overhanging the ventral surface in side view. Ventral margin antero-medially incurved. Cardinal angles broadly rounded. Greatest length of carapace passes below mid-point. The position of greatest height occurs at the posterior cardinal angle although the height at the anterior cardinal angle is only very slightly less. Greatest width behind mid-point. Left valve slightly larger than the right, which it overlaps along the ventral margin, and along the antero-dorsal and postero-dorsal slopes. Shell surface punctate with small, round, **normal pore canal** openings evenly but widely spaced over the carapace. **Hinge** antimerodont: left valve with elongate, strongly loculate terminal sockets, separated by a very short but strongly dentate median bar, above which there is a small accommodation groove. Right valve with 6–7 terminal teeth and a short, loculate median groove. **Inner margin** and **line of concrescence** coincide, **duplicature** of moderate width. **Radial pore canals** short, straight and few in number; 5 posteriorly, up to 13 anteriorly. **Muscle scars** of type **A** (Bate, 1963 : 180). Four oval adductor scars are situated in a vertical row with a large antennal scar situated in front of the uppermost two adductor scars. A much smaller mandibular scar is situated antero-ventrally to the adductors.

Dimensions. Holotype. Io.2358, female carapace, length 0·62 mm.; height 0·37 mm.; width 0·37 mm.

Paratypes. Io.2360, male carapace, length 0·68 mm.; height 0·37 mm.; width 0·34 mm. Io.2362, female left valve, length 0·60 mm.; height 0·36 mm. Io.2363, female right valve, length 0·65 mm.; height 0·37 mm. Io.2366, male left valve, length 0·75 mm.; height 0·41 mm. Io.2367, male right valve, length 0·76 mm.; height 0·38 mm.

Remarks. *Pichottia magnamuris* sp. nov. is very close to *P. muris* Oertli (1959 : 116, pl. 1, figs. 1–10), specimens of which were kindly sent to me by Dr. Oertli, but differs in being very much larger, generally not so acuminate posteriorly and in being more noticeably convex dorsally and ventro-laterally.

Family **SCHULERIDEIDAE** Mandelstam 1959

Subfamily **SCHULERIDEINAE** Mandelstam 1959

Genus ***SCHULERIDEA*** Swartz & Swain 1946

Emended diagnosis. Carapace subovoid with greatest length subventral. Dorsal margin convex, umbonate in larger left valve. Posterior narrowly rounded. Eye swelling either restricted to right valve or present as prominent node on both valves. Hinge paleomerodont. Muscle scars, type **C**. Anterior radial pore canals splayed fan-like, varying in number from 10 to approximately 100. Inner margin and line of concrescence coincide. Shell surface without strong ornamentation.

Remarks. The genus *Schuleridea* was erected by Swartz & Swain (1946) with the type species being described from the Upper Jurassic, Schuler formation, Louisiana. In the following year (1947) Mandelstam erected the genus *Aequacytheridea* with the Tertiary ostracod, *Cytheridea perforata* (Roemer) as type. Both *Aequacytheridea* and *Schuleridea* possess a paleomerodont hinge, type **C** muscle scar pattern (Bate 1963 : 181) and anterior radial pore canals arranged fan-like and curving outwards away from a line drawn through mid-point. Subsequently (Chernysheva 1960 : 370 and Moore 1961 : Q 284) these two genera were considered to be synonymous, *Aequacytheridea* being the junior synonym.

Malz (1958 : 120) noted the evolutionary increase in the number of radial pore canals and considered *Aequacytheridea* to be a subgenus of *Schuleridea*. Kollmann (1960 : 185) recognized 3 subgenera for *Schuleridea*: *Schuleridea* (*Schuleridea*) Swartz & Swain 1946, *Schuleridea* (*Aequacytheridea*) Mandelstam 1947 and *Schuleridea* (n. subgen?)

The three subgenera were not diagnosed nor was the third subgenus named.

The Bathonian species of *Schuleridea* described in the present paper possesses some 18–20 anterior radial pore canals, a number much lower than for previously described species. The number of anterior radial pore canals is considered here to indicate sub-generic identification. Accordingly three subgenera are here recognized: *Schuleridea*, *Aequacytheridea* and a new subgenus, *Eoschuleridea*. All three form an evolutionary sequence with *Eoschuleridea* probably evolving from the genus *Praeschuleridea* Bate (1963 : 207) in early Bathonian or late Bajocian times.

The broad stratigraphic position of the three subgenera and the evolution from *Praeschuleridea* is shown in Table I below. For convenience a numerical range of anterior radial pore canals is given for each subgenus. Overlap at the boundaries is to be expected in any continuous sequence.

The increase in number of the anterior radial pore canals is shown in Table I to be without any break between the three subgenera. This is, at the moment, a purely artificial grouping with each of the subgenera concerned tending to fall somewhere about the centre of the number of pore canals suggested. When the majority of the species for all the subgenera have been described, a more exact range in the number of anterior pore canals may be possible.

TERTIARY	(AEQUACYTHERIDEA)	(Aequacytheridea) is the Tertiary representative of the genus having a sub-ovate carapace and an increased number of anterior radial pore canals (60-100). An eye swelling is generally prominent on both valves. Dies out in the Miocene. Type species Cytheridea perforata (Roemer).
CRETACEOUS UPPER JURASSIC	(SCHULERIDEA)	(Schuleridea) is an Upper Jurassic to Cretaceous subgenus, again sub-ovate in outline with paleomerodont hinge; 30-60 anterior radial pore canals; eye swelling slightly more pronounced. Type species Schuleridea acuminata Swartz and Swain.
BATHONIAN	(EOSCHULERIDEA)	Range of (Eoschuleridea) probably restricted to Bathonian. Sub-ovate in outline with paleomerodont hinge; 18-30 anterior radial pore canals; eye swelling on R.V. Type species Schuleridea (Eoschuleridea) bathonica sp. nov.
BAJOCIAN	PRAESCHULERIDEA	Praeschuleridea first recorded from the Up. Toarcian of Germany, common in L. Bajocian of England. Oval in outline with paleohemimerodont hinge; 11-30 anterior radial pore canals; eye swelling on R.V. Probably becomes extinct in the Upper Jurassic. Type species Cytheridea subtrigona Jones & Sherborn.
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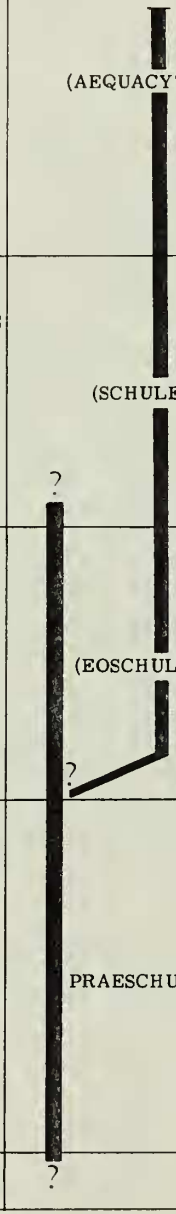

TABLE I. *Evolutionary Series of* Praeschuleridea *and* Schuleridea.

It is interesting to note that just as the number of anterior radial pore canals increases throughout the evolution of the genus *Schuleridea* so also is it the case for *Praeschuleridea* which in the Bajocian (and Aalenian) never appears to possess more than 16 anterior radial pore canals, whereas within the Bathonian the number may be as high as 30.

Subgenus ***EOSCHULERIDEA*** nov.

DIAGNOSIS. *Schuleridea* having reduced number (18–30) anterior radial pore canals. Eye swelling poorly developed. Other details as for genus.

TYPE SPECIES. *Schuleridea* (*Eoschuleridea*) *bathonica* sp. nov.

REMARKS. As previously mentioned, *Eoschuleridea* is both morphologically and geologically situated between *Schuleridea* s.s. and *Praeschuleridea* from which it was most probably derived. The gradual increase in the number of anterior radial pore canals and the development of an eye node produces the evolutionary series indicated above.

Schuleridea (Eoschuleridea) bathonica sp. nov.

(Pl. 7, figs. 7–13, Pl. 8, figs. 1–11)

DIAGNOSIS. *Eoschuleridea* sub-ovate in side view, posteriorly acuminate in female dimorph, oval elongate in male dimorph. Dorsal margin arched, left valve more strongly umbonate in male dimorph. Shell surface punctate with equally spaced normal pore canal openings. Eye swellings indistinct. Eighteen to twenty anterior radial pore canals, 9 posterior canals. Larger left valve overlaping right valve on all sides. Hinge and muscle scars as for genus. Duplicature broad.

HOLOTYPE. Io.2369, female carapace, bed S, Kings Cliffe.

PARATYPES. Io.2370–94, male and female valves and carapaces from beds F & S, Kings Cliffe and bed H, Ketton.

DESCRIPTION. **Carapace** sub-ovate in outline, acuminate posteriorly in the female dimorph where the line of greatest length passes below mid-point. In the more elongate, oval, male dimorph, greatest length passes through mid-point. Greatest height just behind anterior cardinal angle in both dimorphs. Greatest width median. Anterior broadly rounded in the female, whilst the posterior is more narrowly rounded. In the male, both anterior and posterior are equally rounded. Ventro-lateral margin medially convex, ventral margin antero-medially incurved. Dorsal margin convex, especially in the left valve and particularly in the male where the left valve is decidedly " umbonate ". Cardinal angles rounded with the anterior angle right valve male and the posterior angle right valve female being the most sharply defined. Postero-dorsal slopes in the female larger and more nearly straight than in the male. Larger left valve overlaps the smaller right valve on all sides. Shell surface smooth or punctate, depending upon preservation with well developed normal pore canal openings evenly scattered over the valve. **Hinge** paleomerodont.

Left valve with elongate strongly loculate terminal sockets, anteriorly with 6 grooves and posteriorly with 8. Median, connecting groove short, and very finely locellate. Accommodation groove shallow and rather poorly developed. Right valve with terminal elongate dentate ridges bearing 6 anterior and 8 posterior teeth connected by a short, very finely denticulate ridge. The median element in the male dimorph is longer than that present in the female, the number of terminal teeth, is, however, the same. **Inner margin** and **line of concrescence** coincide the **duplicature** being quite broad, especially in the postero-ventral region. **Radial pore canals** long and curved. Anteriorly there appears to be generally 19 in number though 18 and 20 have been observed, arranged fan-like. Posteriorly there are 9 canals, of which 8 are situated below a line through mid-point. **Muscle scars** of type **C**. The four oval adductor scars form a concentric row around the antero-median oval antennal scar. The mandibular scar is antero-ventral in position.

Dimensions. Holotype. Io.2369, female carapace, length 0·74 mm.; height 0·43 mm.; width 0·36 mm.

Paratypes. Io.2370, male carapace, length 0·80 mm., height 0·47 mm., width 0·38 mm. Io.2373, female right valve, length 0·65 mm.; height 0·39 mm. Io.2375, female left valve, length 0·70 mm.; height 0·46 mm. Io.2376, female right valve, length 0·67 mm.; height 0·40 mm. Io.2378, male right valve, length 0·77 mm.; height 0·41 mm. Io.2379, male left valve, length 0·74 mm.; height 0·43 mm.

Remarks. *Schuleridea* (*Eoschuleridea*) *bathonica* sp. nov., may be distinguished from described species of *Schuleridea* not only on variations in the outline but in the number of radial pore canals present. The male dimorph of this species, externally resembles the male dimorph of *Galliaecytheridea*? *kingscliffensis* but may be distinguished by its more oval outline, strongly umbonate left valve and internally by the hinge, muscle scars and radial pore canals.

Genus ***PRAESCHULERIDEA*** Bate 1963

Praeschuleridea quadrata sp. nov.

(Pl. 9, figs. 1–12)

Diagnosis. *Praeschuleridea* with oval carapace in male dimorph, dorsally arched in female. Both dimorphs with distinctly angled posterior cardinal angle. Shell surface punctate. Hinge not strongly paleohemimerodont. Radial pore canals, varying from 20–30 anteriorly.

Holotype. Io.2395, female carapace, bed R, Kings Cliffe.

Paratypes. Io.2396–2413, male and female valves and carapaces, beds R & S, Kings Cliffe.

Description. **Carapace** sub-trigonal in the female dimorph, arched dorsally, with greatest height passing through mid-point. In the male dimorph the carapace is oval-elongate with greatest height being just behind the anterior cardinal angle.

Characteristically in both dimorphs the posterior cardinal angle is sharply angled and in the female set high up away from the posterior. Dorsal margin long and gently convex in the male, umbonate and strongly convex in the female. Anterior cardinal angle in both cases, broadly rounded. Anterior and posterior broadly rounded in the male, posterior more narrowly rounded in the female. Ventral margin convex, incurved slightly antero-medially. Postero-dorsal slope longer in the female than in the male. Greatest length through mid-point in the male, slightly below this in the female. Greatest width median in both dimorphs. Shell surface punctate with rather large, circular **normal pore canal** openings. Left valve larger than the right which it overlaps on all sides other than dorsally, in which region the left valve over-reaches the right. **Hinge** paleohemimerodont. Left valve with terminal loculate sockets connected by a short locellate groove which extends over a low median bar. In male dimorphs the median groove is virtually impossible to distinguish, whilst it is extremely well developed in the female. In some material the dorsal edge of the groove projects noticeably above the groove. Above the median element there is an elongate/triangular accommodation groove. In the right valve the dentate terminal elements consist of anteriorly 6 teeth and posteriorly 7 teeth corresponding with the terminal sockets in the left valve. Median ridge low and rather poorly defined. **Inner margin** and **line of concrescence** coincide producing a **duplicature** of moderate width. Anterior **radial pore canals** splayed fan-like, curving outwards from a line drawn through mid-point. The number present varies within individuals from 20–30. Posteriorly the pore canals also curving away from a line drawn through mid-point are situated largely below this line and vary from approximately 9–18. **Muscle scars**, type **C**: Adductor scars form a slightly crescentic row in front of which is an oval antennal scar, the long axis of which is vertical.

Dimensions. Holotype. Io.2395, female carapace, length 0·63 mm.; height 0·43 mm.; width 0·34 mm.

Paratypes. Io.2397, male carapace, length 0·82 mm., height 0·48 mm.; width 0·37 mm. Io.2398, female left valve, length 0·64 mm.; height 0·45 mm. Io.2399, female right valve, length 0·56 mm.; height 0·35 mm. Io.2400, male left valve length 0·78 mm.; height 0·46 mm.

Remarks. The hinge present in *Praeschuleridea quadrata* sp. nov., although paleohemimerodont, does not possess such a positive median element in the left valve as occurs in all the previously described species of the genus. A second feature of this species is that the number of radial pore canals has increased and appears to vary within the population. It is interesting to note also that those specimens which possess the larger number of anterior pore canals also possess the larger number of posterior canals.

The posterior cardinal angle in the present species is situated much higher up on the carapace than is the case in *P. subtrigona* (Jones & Sherborn), Bate (1963 : 207, pl. 12, figs. 12–16; pl. 13, figs. 1–9).

Schuleridea pentagonalis Swartz & Swain (1946 : 368, pl. 53, figs. 1–8) is externally similar to *Praeschuleridea quadrata* but may be distinguished by the outline of the

dorsal margin which is strongly umbonate in the left valve of *P. quadrata* but only broadly convex in *S. pentagonalis*. Internal details for the latter are not known.

Family **CYTHERURIDAE** Müller 1894

Genus ***METACYTHEROPTERON*** Oertli 1957

Metacytheropteron drupacea (Jones)

(Pl. 10, figs. 1–9)

1884 *Cythere drupacea* Jones : 772, pl. 34, fig. 30.
1957*a* *Metacytheropteron* sp. 50 Oertli : table 1.

Diagnosis. *Metacytheropteron* with elongate/sub-ovate carapace. Greatest height at anterior cardinal angle, posterior acuminate. Dorsal margin broadly convex, especially in left valve. Shell surface strongly ornamented with triangular arrangement of longitudinal and obliquely transverse ridges.

Holotype. IN.43498, female carapace from Richmond boring at 1205 ft., figured Jones 1884, pl. 34, fig. 30.

Other material. Io.2414–18, single valves (male and female dimorphs) from bed M, Ketton.

Description. **Carapace** sub-ovate tapering strongly to the posterior in the female dimorph, rather more elongate in the male. Dorsal margin arched in the left valve, medially convex in the right. Anterior broadly rounded; posterior acuminate, with convex postero-ventral slope and concave postero-dorsal slope (convex in the male dimorph). Ventro-lateral margin convex, particularly in the female. Ventral margin with median incurvature. Greatest length of carapace passes slightly below mid-point; greatest height at the anterior cardinal angle in the left valve, median in the right; greatest width median. Shell surface strongly ornamented with a triangular arrangement of longitudinal and obliquely transverse ridges. The dorsal apex of the triangle (equilateral) meets the dorsal margin above valve mid-point. The centre of the triangle breaks down into a reticulate ornamentation. Ventral surface with 4–5 longitudinal ridges. Numerous **normal pore canal** openings are clearly seen only on the ventral and ventro-lateral surfaces. An oval-elongate **eye swelling** is only really clearly seen in the male dimorph just below the anterior cardinal angle. The deep, oblique groove present behind the eye swelling is, however, well developed in both dimorphs. Left valve larger than the right which it overlaps along the ventral margin and along the antero-dorsal slope, and probably also along the postero-dorsal slope. Anteriorly the left valve appears to merely extend beyond the right. Elsewhere the valve relationships are not clearly seen in the present material. **Hinge** antimerodont. Left valve with elongate loculate sockets and a denticulate median bar, above which there is only a very poorly developed accommodation groove. Right valve with approximately 6 posterior teeth and 8 anterior teeth, median groove locellate. **Inner margin** and **line of concrescence** coincide, although perhaps not exactly so around the anterior.

Radial pore canals straight, rather strongly developed and widely spaced, 8 anteriorly at least 3 posteriorly but probably no more than 4. **Muscle scars** not observed.

Dimensions. Holotype. IN.43498, female carapace, length 0·50 mm.; height 0·30 mm.; width 0·29 mm.

Other material. Io.2414, female left valve, length 0·54 mm.; height 0·33 mm. Io.2415, male left valve, length 0·67 mm.; height 0·35 mm. Io.2416, male right valve, length 0·60 mm.; height 0·30 mm. Io.2417, male right valve, length 0·61 mm.; height 0·30 mm.

Remarks. The holotype is the only complete carapace available at the present time and this has suffered a certain amount of crushing in the postero-dorsal region.

Dr. H. J. Oertli kindly loaned me material of the type species, *Metacytheropteron elegans* Oertli (1957 : 664, pl. 4, figs. 116–124) to compare with the species described here. Although very close to *M. elegans*, *M. drupacea* may be distinguished by the more strongly arched dorsal margin in the left valve and is, therefore, not so narrow and elongate in lateral view. Ornamentally *M. drupacea* has the more definitely triangular arrangement of ridges without such a large central reticulate development.

Family **PROGONOCYTHERIDAE** Sylvester-Bradley 1948

Subfamily **PROGONOCYTHERINAE** Sylvester-Bradley 1948

Genus ***PROGONOCYTHERE*** Sylvester-Bradley 1948

Progonocythere levigata sp. nov.

(Pl. 10, figs. 10–14, Pl. 11, figs. 1–9)

Diagnosis. *Progonocythere* with subquadrate/elongate punctate carapace over which large, circular, normal pore canal openings are evenly spaced. Dorsal outline of left valve, female dimorph, characteristically umbonate, anterior cardinal angle being set well back only just in front of valve centre. Small marginal denticles may occur anteriorly and posteriorly in right valve. Ventro-lateral margin broadly convex. Anterior and posterior borders compressed. Internal details as for genus.

Holotype. Io.2419, female left valve, bed H, Ketton.

Paratypes. Io.2420–33, carapaces and single valve (both dimorphs), bed H, Ketton.

Description. **Carapace** subquadrate with high, arched dorsal outline in the female dimorph, elongate in the male. Anterior broadly rounded with, in two right valves, a small group of denticles situated at mid-height. Posterior narrowly rounded situated high on the male carapace; at mid-height in the female left valve, subventral in the female right valve where a small group of denticles may be found on the postero-ventral slope. The postero-dorsal slope in both female valves is very steeply angled. Dorsal margin broadly convex in the male, steeply angled in the

female, especially within the left valve where the anterior cardinal angle is situated just anterior of valve middle, producing an umbonate outline. Ventro-lateral margin strongly convex. Ventral margin with antero-median incurvature. Greatest length above mid-point in the male left valve; through mid-point in the female left valve, below mid-point in the right. Male right valve damaged but greatest length probably passes through mid-point. Greatest height through the anterior cardinal angle in the female, median in the male. Greatest width median. Anterior and posterior marginal borders compressed. Shell surface finely punctate with prominent, evenly spaced, **normal pore canal** openings. Left valve larger than the right which it overlaps along the ventral margin and slightly along the antero-dorsal slope. Elsewhere the left valve over-reaches the right. **Hinge** entomodont. Left valve with strongly loculate terminal sockets and a dentate median bar, the anterior portion of which is even more strongly dentate. A long, narrow accommodation groove is present above the median element. Right valve with 7 posterior teeth and an indeterminate number of anterior teeth (probably 8–9), and a loculate median groove, the anterior part of which is greatly expanded. **Inner margin** and **line of concrescence** coincide; **duplicature** only of moderate width. **Radial pore canals** not distinguished. **Muscle scars** of type A. The 4 adductor scars are in a subvertical row with the round antennal scar situated opposite and close to the most dorsal scar in the male. In the female the antennal scar is slightly lower in position and occurs a good deal further away from the adductors.

Dimensions. Holotype. Io.2419, female left valve, length 0·81 mm.; height 0·54 mm.

Paratypes. Io.2420, female right valve, length 0·82 mm.; height 0·49 mm. Io.2421, male left valve, length 0·85 mm.; height 0·50 mm. Io.2422, male right valve, length (broken) 0·93 mm.; height 0·51 mm. Io.2423, female carapace, length 0·71 mm.; height 0·46 mm.; width 0·35 mm.

Remarks. *Progonocythere levigata* approaches *P. cristata* Bate (1963 : 191, pl. 4, figs. 5–15, pl. 5, figs. 1–6) in outline but does not develop the ventro-lateral overhang characteristic of the latter. The male dimorph of *P. levigata* also is a much more oval ostracod in side view. *Progonocythere stilla* Sylvester-Bradley (1948 : 190, pl. 12, figs. 1, 2, pl. 13, figs. 1, 2) is easily distinguishable by its more truncated posterior.

Progonocythere rugosa sp. nov.

(Pl. 11, figs. 10–14, Pl. 12, figs. 1–9, Pl. 13, fig. 2.)

Diagnosis. *Progonocythere* with coarse ornamentation of pits, grooves and ridges aligned parallel to ventro-lateral and terminal margins. Carapace subdivided by deep median, vertical sulcus. Ventro-lateral margin extended keel-like below ventral surface. Internal details as for genus.

Holotype. Io.2434, female carapace, bed S, Kings Cliffe.

Paratypes. Io.2435–52, both dimorphs, carapaces and single valves from beds R & S, Kings Cliffe, Dane Hill, and bed S, Ketton.

DESCRIPTION. **Carapace** subquadrate, more elongate, however, in the male dimorph. Ventro-lateral margin strongly overhangs the ventral surface and tapers to form a keel-like structure, particularly in the postero-ventral region. Greatest length of carapace tends to pass slightly above mid-point in both dimorphs, the narrowly rounded posterior being set high up on the carapace. Anterior broadly rounded. Dorsal margin with slight concavity behind anterior cardinal angle, through which the line of greatest height passes. This angle is set further back in the female left valve than in the male; a condition which to some extent also applies in the right valve. Antero-dorsal slope tends to be rather long and convex, whilst the postero-dorsal slope is concave and much shorter. Greatest width just behind the median sulcus. Anterior and posterior marginal borders compressed. Ventral margin distinctly incurved antero-medially. Shell surface strongly ornamented. Ventrally the V-shaped ventral surface, bounded on either side by the ventro-lateral overhang, is ornamented by 3 prominent longitudinal ridges per valve, not counting the ridge which produces the keel of the ventro-lateral margin. Lateral surface coarsely ornamented by a series of pits, grooves and complimentary ridges aligned parallel to the ventro-lateral and terminal margins. Particularly in the female, there is a deep vertical sulcus developed about valve centre. **Normal pore canals** few in number, large and widely spaced. Left valve larger than the right, which it overlaps noticeably along the ventral margin, and both antero- and postero-dorsally. Anteriorly the left valve projects slightly beyond the right and strongly over-reaches dorsally. **Hinge** entomodont. Left valve with coarsely loculate terminal sockets (8 loculi anteriorly and 7 posteriorly), median bar dentate, more coarsely so in anterior half. Accommodation groove broad and rather shallow. Right valve with 8 anterior teeth and 7 posterior teeth; median groove loculate, expanded anteriorly. **Muscle scars** of type **A**. The antero-dorsal antennal scar is quite large in the single specimen showing it, and appears to be formed by a fusion of two smaller, round, scars. Antero-ventral scar round, also larger than the four round adductor scars which are arranged in a slightly crescentic row. **Inner margin** and **line of concrescence** coincide, the **duplicature** being rather narrow. As a result the widely spaced, straight, **radial pore canals** are rather short. Anteriorly there are 8 whilst posteriorly only 3.

DIMENSIONS. Holotype. Io.2434, female carapace, length 0·72 mm.; height 0·49 mm.; width 0·42 mm.

Paratypes. Io.2435, male carapace, length 0·80 mm.; height 0·49 mm.; width 0·39 mm. Io.2436, female right valve, length 0·63 mm.; height 0·40 mm. Io.2437, male left valve, length 0·74 mm.; height 0·46 mm. Io.2438, female right valve, length 0·65 mm.; height 0·40 mm.

REMARKS. *Progonocythere rugosa* sp. nov. is distinguishable from other species of the genus by the type and coarseness of the ornamentation which in many ways is similar to that often found in species of *Glyptocythere*. However, as with other species of *Progonocythere*, the absence of a dorsomedian projection in the right valve prevents this species being a *Glyptocythere*. It is, in all other details, typical of the genus in which it has been placed.

Progonocythere triquetra sp. nov.

(Pl. 12, figs. 10–13, Pl. 13, figs. 1, 3–9)

Diagnosis. *Progonocythere* with high domed, sub-triangular carapace in female; elongate-subrectangular carapace in male. Both dimorphs in dorsal view have steeply angled lateral surfaces only slightly convex. Ventro-lateral margin extended below ventral surface. Ventral surface ornamented by longitudinal ridges; lateral surface punctate, over which are widely scattered a number of large, circular, normal pore canal openings. Internal details as for genus.

Holotype. Io.2453, female carapace, bed J, Kings Cliffe.

Paratypes. Io.2454–63, male and female single valves and female carapace from beds H & J, Kings Cliffe and bed H, Ketton.

Description. **Carapace** sub-triangular in the female dimorph having a high domed dorsal outline (left valve) with steeply angled dorsal margins. The male dimorph is much more rectangular in outline and does not possess the high dorsal outline of the female. Greatest length of carapace passes through mid-point with the greatest height at the anterior cardinal angle and greatest width median. Anterior broadly rounded, posterior triangular with concave postero-dorsal slope and convex postero-ventral slope. Dorsal margin very slightly convex, only gently sloping to the posterior in all valves other than the female left valve where it is steeply angled. Antero-dorsal slope convex and short, again in all valves other than in the female left valve where it is long, due to the situation of the anterior cardinal angle only just anterior of valve centre. Ventro-lateral margin strongly convex and extended below the ventral surface. Ventral margin incurved antero-medially, only very shallow in the male left valve and with a ventral " lip " in the right valve. Ventral surface of each valve ornamented by 4–5 longitudinal ridges. Lateral surface punctate. **Normal pore canal** openings widely scattered, large, circular and comparatively few in number. Left valve larger than the right which it overlaps along the ventral surface, in the region of the cardinal angles but strongly over-reaches mid-dorsally. **Hinge** entomodont. Left valve with terminal loculate sockets and a dentate median bar, the dentations being much coarser in the anterior half, above which is an elongate, deep, accommodation groove. Right valve with 6 anterior teeth and 7 posterior teeth in both males and females. All teeth are dorsally bifid. Median groove strongly loculate and expanded anteriorly. **Inner margin** and **line of concrescence** coincide. **Duplicature** narrow; **selvage** prominent. A narrow **flange** extends around the anterior and posterior margins and along the ventral margin in which region it forms the ventral " lip " below the median incurvature. The flange is only clearly seen in the right valve of both dimorphs. **Radial pore canals** short, straight and widely spaced, 8 anteriorly. **Muscle scars**, type A. Adductor scars oval, aligned in a slightly crescentic row with a round antero-dorsal antennal scar and a round antero-ventral mandibular scar.

Dimensions. Holotype Io.2453, female carapace, length 0·75 mm.; height 0·54 mm.; width 0·40 mm.

Paratypes. Io.2454, female left valve, length 0·62 mm.; height 0·45 mm. Io.2455, female right valve, length 0·66 mm.; height 0·40 mm. Io.2456, male left valve, length 0·86 mm.; height 0·50 mm. Io.2457, male right valve, length 0·70 mm.; height 0·37 mm. Io.2458, female carapace, length 0·79 mm.; height 0·55 mm.; width 0·38 mm.

Remarks. The subtriangular carapace in the female and the steeply sloping lateral sides when viewed dorsally readily distinguish this species from others of the genus.

Genus *GLYPTOCYTHERE* Brand & Malz 1962

Remarks. The genus first appeared in print in Brand & Malz 1962*a* when 7 species of *Glyptocythere* were described. The diagnosis of the genus and the erection of a type species was not published until a short while later in Brand & Malz 1962*b*.

Glyptocythere guembeliana (Jones)

(Pl. 13, figs. 10–16, Pl. 14, figs. 1–8)

1884 *Cythere guembeliana* Jones : 772, pl. 34, figs. 32, 33 [*non* fig. 31].
1888 *Cytheridea pulvinar* Jones & Sherborn : 266, pl. 3, fig. 2*a–c*.

Diagnosis. *Glyptocythere* with subquadrate carapace, elongate in male dimorph. Lateral surface with transverse ridges extending down from dorsal margin although generally poorly developed in most specimens. Marginal borders compressed. Ventro-lateral margin evenly convex in female, sharply directed upwards posteriorly in male right valve; may possess deep longitudinal groove in either dimorph or may possess short blade-like extension. Hinge weakly entomodont.

Lectotype. Selected here, IN.43493, male right valve, Great Oolite, Richmond boring at a depth of 1205 ft., figured Jones 1884, pl. 34, fig. 33.

Paralectotype. Io.3338, male carapace from Richmond boring, depth 1205 ft.

Jones's collection. I.1858, lectotype of *Cytheridea pulvinar* from the Blue Fullers Earth Clay; Midford, Bath. A female right valve. Figured Jones & Sherborn 1888, pl. 3, fig. 2*a–c*; Io.2464, male right valve fragment from the Blue Fullers Earth Clay; Midford Bath.

Other material. Io.2465–2512, male and female valves and carapaces from beds F, O & R, Kings Cliffe; beds H & L, Ketton and bed U, Ancaster.

Description. **Carapace** somewhat variable in size, subquadrate in the female, more elongate in the male. Greatest length of carapace passes through mid-point whilst the greatest height median or at the anterior cardinal angle. Greatest width behind mid-point. Anterior broadly rounded in the left valve, tending to develop a short, slightly concave antero-dorsal slope in the right valve. Posterior triangular with a strongly concave, short, postero-dorsal slope and a longer, convex, postero-ventral slope. Ventro-lateral margin broadly convex, obliquely angled posteriorly

in the male right valve. Ventral margin with a median incurvature. Dorsal margin strongly convex medially in the right valve, less obviously so in the left. Cardinal angles prominent. Shell surface punctate and generally poorly ornamented though some specimens may develop quite prominent transverse ridges which extend downwards to die out at a line drawn through mid-point. A broad, shallow depression is most noticeably developed in the right valve just behind the anterior cardinal angle. A short blade-like crest may be developed in some specimens on the ventro-lateral margin, whilst others may develop a short but deep, longitudinal groove, just above the ventro-lateral margin. **Normal pore canals** with large, circular openings evenly spaced over the carapace. Left valve larger than the right which it overlaps along the ventral margin and slightly along the antero-dorsal slope. Elsewhere, along the dorsal margin the left valve over-reaches the right. **Hinge** very poorly entomodont. Left valve with terminal, elongate, loculate sockets between which is a strong, coarsely dentate median bar, the teeth of which show a tendency in the anterior portion to become partially united in pairs. Accommodation groove poorly represented. Right valve with 6 anterior and 7 posterior, dorsally bifid, teeth. Median groove coarsely loculate, expanded very slightly in the anterior portion. **Inner margin** and **line of concrescence** coincide. **Duplicature** of moderate width with anteriorly 8, straight and widely spaced **radial pore canals** and 3 posteriorly, 2 of which are situated together at the point of the posterior margin. **Muscle scars** of type **A** with the antero-dorsal antennal scar being much larger than any of the adductors.

Dimensions. Lectotype. IN.43493, male right valve, length 0·96 mm.; height 0·49 mm. Paralectotype. Io.3338, male carapace, length 0·71 mm.; height 0·36 mm.; width 0·32 mm.

Other material. I.1858, female right valve, length 0·82 mm.; height 0·47 mm. Io.2465, male left valve, length 0·71 mm.; height 0·37 mm. Io.2466, male right valve, length 0·83 mm.; height 0·42 mm. Io.2467, female left valve, length 0·70 mm.; height 0·45 mm. Io.2468, female right valve, length 0·72 mm.; height 0·42 mm. Io.2469, female right valve, length 0·66 mm.; height 0·39 mm. Io.2471, male carapace, length 0·73 mm.; height 0·40 mm.; width 0·36 mm. Io.2472, female right valve, length 0·78 mm.; height 0·45 mm. Io.2473, female carapace, length 0·73 mm.; height 0·46 mm.; width 0·39 mm.

Remarks. Apart from the paralectotype, all specimens from the Jones collection are larger than those of the same sex present within the Upper Estuarine Series. That a male dimorph (the paralectotype) of small size occurs with larger specimens suggests that the adult size of this species is somewhat variable. Also variable within a population is the tendency in some specimens to develop a deep groove near to the ventro-lateral margin and in others for the ventro-lateral margin to be thickened or extended into a blade-like keel. The ornamental features of this species readily identify it from existing species of the genus.

The two species placed in synonymy are simply male and female dimorphs; Jone's *Cythere guembeliana* being the male and *Cytheridea pulvinar* described by Jones & Sherborn, the female.

Glyptocythere juglandica (Jones)

(Pl. 14, fig. 9)

1884 *Cythere juglandica* Jones ; 766, 768, pl. 34, figs. 36, 37.
1888 *Cythere juglandica* var. *major* Jones & Sherborn : 255, pl. 4, fig. 2*a–b*.
1948 *Progonocythere juglandica* (Jones) Sylvester-Bradley : 193, pl. 12, figs. 5, 6, pl. 13, fig. 8.
1963 *Progonocythere juglandica juglandica* (Jones) ; Grekoff : 1731, pl. 3, fig. 55.
1963 *Progonocythere? juglandica* (Jones) ; Oertli, pls. 28, 29, 30.

MATERIAL. Io.2513–17, male and female carapaces and a female left valve from beds N, O & S, Kings Cliffe.

REMARKS. The strong ornamentation and characteristic mid-dorsal extension of the right valve places this species within the genus *Glyptocythere*. The doubtful position of *juglandica* within *Progonocythere* has been noted by Oertli (1963).

Genus ***KLIEANA*** Martin 1940

Klieana levis Oertli

(Pl. 14, figs. 10–13, Pl. 15, figs. 1–5)

1957 *Klieana levis* Oertli : 760, pl. 22, figs. 13–19.

MATERIAL. Io.2518–36, male and female carapaces and single valves from bed Q, Kings Cliffe; bed U, Ancaster and bed L, Kettering.

REMARKS. Due to the kindness of Dr. Oertli, I have been able to examine some of the material originally described, and to compare it with the present material. The specimens of *Klieana levis*, which are found, often in fairly large numbers, within the Upper Estuarine Series tend to be slightly larger than those described by Oertli, which have an average length of 0·50–0·60 mm., and possess a punctate rather than a smooth carapace. All the specimens figured by Oertli are female dimorphs when compared with the present material and as he states (p. 760) that dimorphism is not recognized with certainty it is probable that the male dimorphs, which are never very common, were not found in the French material. The male dimorph is a very noticeable form much more elongate than the female and does not have the strongly arched dorsal margin to the left valve. The **muscle scars**, not observed in Oertli's material, are of type **A**. **Radial pore canals** straight and widely spaced, 8 anteriorly and 4 posteriorly. **Hinge** antimerodont.

DIMENSIONS. Io.2518, female carapace, length 0·61 mm.; height 0·40 mm.; width 0·32 mm. Io.2520, female right valve, length 0·63 mm.; height 0·39 mm. Io.2521, female left valve, length 0·66 mm.; height 0·43 mm. Io.2522, male carapace, length 0·74 mm.; height 0·36 mm.; width 0·35 mm.

Genus ***LOPHOCYTHERE*** Sylvester-Bradley 1948

Lophocythere ostreata (Jones & Sherborn)

1888 *Cytheridea ostreata* Jones & Sherborn : 271, pl. 4, fig. 6.
1948 *Lophocythere ostreata* (Jones & Sherborn) Sylvester-Bradley : 195, pl. 14, figs. 1–4, pl. 15, figs. 1, 2.

Remarks. A single, juvenile carapace (Io.2540) found in bed S, Kings Cliffe. Not figured.

Lophocythere scabra scabra Triebel

(Pl. 15, fig. 6)

1951 *Lophocythere scabra* Triebel : 95, pl. 46, figs. 26–30, pl. 47, figs. 31–34.
1960 *Lophocythere scabra scabra* Triebel ; Lutze : 429, pl. 37, fig. 1.
1962 *Lophocythere scabra scabra* Triebel ; Brand & Fahrion : 147, pl. 21, fig. 32.
1963 *Lophocythere scabra* Triebel ; Oertli : 43, pls. 26, 28–30.

Material. Io.2537–39 and Io.2541, male and female valves and carapaces from beds F & R, Kings Cliffe.

Remarks. Like *Glyptocythere juglandica*, *Lophocythere scabra scabra* is a typical Bathonian ostracod and is common in the majority of the marine sediments of the Upper Estuarine Series.

Lophocythere septicostata sp. nov.

(Pl. 15, figs. 7–13, Pl. 16, figs. 1–4)

1888 *Cytheridea bradiana* Jones & Sherborn : 272, pl. 4, figs. 11*a–c*.

Diagnosis. *Lophocythere* having seven longitudinal ridges on lateral surface and two on ventral surface. A vertical ridge extends downwards from oval eye swelling. Interspaces between ridges, punctate, with large, circular, normal pore canal openings. Anterior and posterior marginal borders compressed.

Holotype. Io.2542, female carapace from bed B, Kettering.

Paratypes. Io.2543–49, male and female carapaces and male left valve from bed B, Kettering; bed V, Ancaster and bed N, Kings Cliffe. I.1843, female right valve, described by Jones & Sherborn as *Cytheridea bradiana* figd., pl. 4, figs. 11*a–c*, from the Blue Fullers Earth Clay; Midford, Bath. Eight male and female specimens (Io.3600–07) of the Möckler collection from the Fullers Earth; Midford nr. Bath.

Description. **Carapace** subquadrate in the female dimorph, elongate in the male. Greatest length passes through mid-point whilst greatest height occurs at the anterior cardinal angle in the female, posteriorly in the male. Greatest width in the posterior third. The carapace possesses prominent, well rounded cardinal angles with the dorsal margin between tending to be medially concave in the left valve, gently convex in the right. The ventral margin is incurved medially whilst the ventral surface is overhung by the convex ventro-lateral margins. Anterior high, broadly rounded; posterior triangular with concave postero-dorsal slope and convex postero-ventral slope. Anterior and posterior marginal borders compressed in the female, only posteriorly so in the male. Shell surface laterally ornamented by a series of 7 oblique, longitudinal ridges which in the anterior half bend downwards and fuse together so that only 2 ridges extend as far as the antero-ventral margin.

The median ridges tend to be short but one of these is long and extends to the antero-ventral margin, although it is not always the same ridge in each specimen which does this. An oval **eye swelling**, situated below the anterior cardinal angle, has a prominent ridge extending from it as far as the uppermost of the two ridges. Surface of carapace between the ridges is punctate and in some specimens also seen to possess large, circular **normal pore canal** openings. Ventral surface possesses two further longitudinal ridges. Left valve larger than the right which it overlaps along the ventral margin and slightly at the cardinal angles. Elsewhere dorsally, the left overreaches the right. **Hinge** entomodont, left valve not clearly seen but in the right there are 5 anterior teeth and 6 posterior teeth, the coarsely loculate median groove being noticeably expanded in its anterior portion. **Inner margin** and **line of concrescence** coincide, no **radial pore canals** observed. A narrow **flange** extends around the anterior margin and continues much reduced outside the ventral margin. **Muscle scars** not observed.

Dimensions. Holotype. Io.2542, female carapace, length 0·72 mm.; height 0·40 mm.; width 0·34 mm.

Paratypes. I.1843, female right valve (Jones & Sherborn colln.) length 0·64 mm.; height 0·33 mm. Io.2546, female carapace, length 0·72 mm.; height 0·43 mm.; width 0·35 mm. Io.2547, male carapace, length 0·77 mm.; height 0·36 mm.; width 0·35 mm.

Remarks. Jones (1884 : 772) described a new ostracod species named *Cythere bradiana*, subsequently placed into *Lophocythere* by Sylvester-Bradley (1948 : 196). Jones & Sherborn (1888) described material from the Fullers Earth near Bath and identified some specimens as belonging to *Cythere bradiana* although they changed the generic name to *Cytheridea* without comment. This material was not, however, conspecific with their earlier *Cythere bradiana* although like that species, belongs in the genus *Lophocythere*. Jones & Sherborn's material is included here in the new species *Lophocythere septicostata*. *L. septicostata* differs from *L. bradiana* in the number of lateral ridges and absence of reticulation between (although a single male carapace, Io.2547, shows some evidence of reticulation), characters which also serve to distinguish the present species from *L. multicostata* Oertli (1957 : 667). In addition, the compressed anterior marginal border present in the female dimorph of *L. septicostata* distinguishes this species in dorsal view from the other two species. The possession of an eye swelling identifies this species as belonging to the genus *Lophocythere* rather than to the related genus *Terquemula* Blaszyk & Malz 1965.

Lophocythere transversiplicata sp. nov.

(Pl. 16, figs. 5–15)

Diagnosis. *Lophocythere*, with three primary longitudinal ridges; secondary transverse ridges radiating down from ridge to produce broad reticulation between longitudinal ridges. All three longitudinal ridges converging towards antero-ventral

margin. Minor transverse ridge extending down from region of anterior cardinal angle. Ventral surface also ornamented with longitudinal ridges.

HOLOTYPE. Io.2625, female carapace, bed J, Ketton.

PARATYPES. Io.2626–29, 3087–89, male and female carapaces and single valves, bed J, Ketton.

DESCRIPTION. **Carapace** subquadrate to subrectangular, the more elongate specimens being the males. Anterior high and broadly rounded; posterior triangular with concave postero-dorsal slope and convex postero-ventral slope. Anterior cardinal angle, through which passes the line of greatest height, prominent; the right valve has a low **eye swelling** situated below. Posterior cardinal angle not so prominent as the anterior angle. Dorsal margin of left valve overreached strongly by an extension of the valve. Ventral margin incurved antero-medially. Greatest length of carapace passes through mid-point whilst the greatest width lies in the posterior third. Ventral surface ornamented by four prominent longitudinal ridges per valve. Lateral surface with three longitudinal ridges which converge towards the antero-ventral margin. The dorsal ridge also bends down posteriorly to join the median ridge below. A series of minor transverse ridges extend down from the dorsal ridge and produce a coarse reticulation between the longitudinal ridges. In addition a transverse ridge extends down from the region of the anterior cardinal angle to fuse with the three longitudinal ridges. Left valve is larger than the right which it overlaps along the ventral margin and slightly at the cardinal angles. Dorsally the left over-reaches the right. **Hinge** entomodont. Left valve with terminal loculate sockets, virtually no accommodation groove and a dentate median bar. Because of damage to this bar, the typical entomodont character cannot be seen. Right valve with 5 anterior and 6 posterior teeth. Median groove loculate, expanded in the anterior half. **Inner margin** and **line of concrescence** coincide. **Radial pore canals** straight, 9 anteriorly and 4 posteriorly. Other internal details not observed.

DIMENSIONS. Holotype. Io.2625, female carapace, length 0·56 mm.; height 0·34 mm.; width 0·31 mm.

Paratypes. Io.2626, male carapace, length 0·70 mm.; height 0·34 mm.; width 0·31 mm. Io.2627, female right valve, length 0·53 mm.; height 0·28 mm. Io.2628, male right valve, length 0·68 mm.; height 0·27 mm. Io.2629, male left valve, length 0·62 mm., height 0·32 mm.

REMARKS. *Lophocythere transversiplicata* sp. nov. bears some resemblances to *L. flexicosta* Triebel (1951 : 97, pl. 48, figs. 46–48) and *L. plena* Triebel (1951 : 100, pl. 49, figs. 60–63) but differs from both in not having such a neat reticulate ornamentation over the lateral surface. The reticulation that does occur being produced simply by branching and anastomosing transverse ridges restricted to the interspaces between the longitudinal ridges and not generally present over the entire lateral surface. It is distinguished from species of *Terquemula* Blaszyk & Malz 1965 on ornamentation and possession of an eye swelling.

Genus *MACRODENTINA* Martin 1940

Remarks. Malz (1958) erected three subgenera for the genus, namely:—

***Macrodentina* (*Dictyocythere*)**

***Macrodentina* (*Macrodentina*)**

***Macrodentina* (*Polydentina*)**

Each subgenus is identified by the type of amphidont hinge present, in all cases the median element being smooth. The first appearance of the genus according to the present literature occurs towards the base of the Upper Jurassic (Kimmeridge). Within the Upper Estuarine Series, however, there is found, often in large numbers, a species of ostracod which undoubtedly belongs to the genus *Macrodentina*. Here the hinge is a much more primitive type with a dentate/loculate median element. This form extends the range of the genus down into the Middle Jurassic and a new subgenus, *Mediodentina*, is erected to contain it.

Subgenus *MEDIODENTINA* nov.

Diagnosis. *Macrodentina* with entomodont hinge. Other details as for genus.

Type species. *Macrodentina* (*Mediodentina*) *bathonica* sp. nov.

Macrodentina (*Mediodentina*) *bathonica* sp. nov.

(Pl. 17, figs. 1–12, Pl. 18, figs. 1–4)

Diagnosis. *Mediodentina* having sub-quadrate to sub-rectangular carapace with prominent cardinal angles. Tendency to develop small marginal denticles antero- and postero-ventrally. Dimorphic. Shell surface strongly punctate with large, circular, normal pore canal openings. Punctation may be so well developed as to produce almost reticulate type ornamentation.

Holotype. Io.2550, female carapace, bed Q, Kings Cliffe.

Paratypes. Io.2551–72, male and female carapaces and single valves from beds J, Q & R, Kings Cliffe and bed L, Ketton.

Description. **Carapace** subquadrate in the female dimorph, sub-rectangular in the more elongate male dimorph. Greatest length in both sexes passes through mid-point with the greatest height through the anterior cardinal angle and the greatest width in the posterior third. Anterior high, broadly rounded; posterior quite broad and also rounded, although the short, almost vertical postero-dorsal slope gives a concavity just below the posterior cardinal angle. Both cardinal angles are prominent but the posterior one is especially so. Dorsal margin slightly convex in the female and with a very shallow concavity behind the anterior cardinal angle. In the male these features are more strongly exaggerated. Ventro-lateral margin

convex, overhanging the ventral surface. Ventral margin antero-medially incurved. Left valve larger than the right which it overlaps along the ventral margin. In the region of the antero- and postero-dorsal slopes the valve relationship is one of overreach rather than overlap. Shell surface strongly punctate, the punctation in a single specimen almost giving rise to reticulation—the punctae being enlarged almost to size of pits. **Normal pore canal** openings are large and circular and both evenly and widely spaced over the carapace. Small marginal denticles are commonly developed in the postero-ventral and antero-ventral regions. **Hinge** strongly entomodont. Left valve with oval, coarsely loculate terminal sockets and a coarsely dentate median bar, the denticles being greatly enlarged in the anterior portion. Accommodation groove shelf-like, though rather narrow, particularly in the male dimorph. Right valve with 6 anterior and 6 posterior, dorsally bifid, teeth. Median groove coarsely loculate and greatly expanded in its anterior half. **Inner margin** and **line of concrescence** coincide, **duplicature** being of moderate width. Anterior **radial pore canals** 8 in number, straight and widely spaced; only 2–4 posteriorly. Right valve has a prominent " lip " developed just below the median incurvature. **Muscle scars** of type **A**. The four adductor scars are rather small as is the round antennal scar which is antero-dorsal in position.

Dimensions. Holotype. Io.2550, female carapace, length 0·86 mm.; height 0·51 mm.; width 0·42 mm.

Paratypes. Io.2551, male carapace, length 0·85 mm.; height 0·45 mm.; width 0·37 mm. Io.2552, male left valve, length 0·85 mm.; height 0·46 mm. Io.2553, male left valve, length 0·95 mm.; height 0·51 mm. Io.2554, female left valve, length 0·84 mm.; height 0·54 mm. Io.2555, immature female left valve, length 0·65 mm.; height 0·40 mm. Io.2556, female right valve, length 0·68 mm.; height 0·43 mm. Io.2558, juvenile left valve, length 0·67 mm.; height 0·41 mm. Io.2559, juvenile right valve, length 0·61 mm.; height 0·38 mm.

Remarks. In some ways this species resembles the ostracod Indet. genus sp. *A*. Oertli (1957 : 676) but may be distinguished by the possession of more prominent cardinal angles, especially posteriorly, and the convexity of the ventro-lateral margin. None of these features is particularly well developed in Oertli's material.

Genus *MARSLATOURELLA* Malz 1959

Marslatourella bullata sp. nov.

(Pl. 18, figs. 5–14, Pl. 19, figs. 1, 2)

Diagnosis. *Marslatourella* with subquadrate carapace; prominent eye node with short vertival ridge extending ventrally from it. Ventro-lateral margin with two knob-like extensions. Shell surface punctate with anterior denticles. A small " lip " of right valve overlaps left mid-ventrally. Carapace equivalve.

Holotype. Io.2573, right valve from bed H, Ketton.

Paratypes. Io.2574–81, single valves and complete carapaces from beds H & N, Ketton; bed R, Kings Cliffe and bed J, Kettering.

Description. **Carapace** subquadrate with well rounded anterior; rounded-triangular posterior; straight dorsal margin with acute cardinal angles and strongly concave (medially) ventral margin. Male dimorph slightly more elongate than the female for a given height. Greatest length passes through mid-point with the greatest height situated at the anterior cardinal angle. Greatest width median. The carapace here is equivalve with the left and right valves fitting side by side. The left valve very slightly projects beyond the right terminally whilst mid-ventrally, a small " lip " of the right valve overlaps the left. A narrow **flange** extends around the free margin of each valve and especially around the anterior is broken up into a number of small denticles. Shell surface punctate. Ventro-lateral margin extended into 2 prominent knob-like processes which terminally tend to flatten out and become blade-like. **Eye node** prominent at the anterior cardinal angle with a short, straight ridge extending ventrally from it. **Normal pore canal** openings small and rather numerous. **Hinge** delicately antimerodont. Left valve with a long, finely denticulate median bar and small terminal sockets which appear to be ventrally open to the interior of the valve. Right valve with a long narrow groove, presumably locellate and finely dentate terminal ridges, the exact number of teeth involved not determined. **Inner margin** and **line of concrescence** coincide, **radial pore canals** straight, rather thin and well spaced, approximately 16 anteriorly and 6 posteriorly. **Muscle scars** as seen through the carapace appear to be of type **A**, the antero-dorsal antennal scar being round.

Dimensions. Holotype. Io.2573, female right valve, length 0·68 mm.; height 0·39 mm.

Paratypes. Io.2575, male carapace, length 0·78 mm.; height 0·41 mm.; width 0·34 mm. Io.2578, female left valve, length 0·69 mm.; height 0·40 mm. Io.2579, female carapace, length 0·77 mm.; height 0·43 mm.; width 0·37 mm.

Remarks. *M. bullata* sp. nov. is larger than the type species (*M. exposita* Malz 1959 : 20) of which Dr. Malz kindly sent me material for comparison purposes. *M. exposita* has an average length of 0·51–0·59 mm. *M. bullata* further differs from the type species in the form of the ventro-lateral outgrowths which are knob-like rather than alate and in its more rounded posterior. The denticulate flange, especially around the anterior margin is a further distinguishing feature of this species.

Genus *MICROPNEUMATOCYTHERE* Bate 1963

Micropneumatocythere postrotunda sp. nov.

(Pl. 19, figs. 3–10, 13–16)

Diagnosis. *Micropneumatocythere* having ovoid rather tumid carapace; arched dorsal outline; broadly rounded posterior; more narrowly rounded anterior. Shell surface punctate with 3 longitudinal ridges extending along ventral surface of each valve. Normal pore canal openings fairly large. Low swelling occurs just below anterior cardinal angle. Internal details as for genus.

PARATYPES. Io.2583–91, single valves and carapaces from beds J, P & R, Kings Cliffe.

HOLOTYPE. Io.2582, carapace, bed P, Kings Cliffe.

DESCRIPTION. **Carapace** tumid, ovoid in outline with terminally flattened broadly rounded posterior and a more narrowly rounded blunted anterior. Dorsal margin arched with rounded cardinal angles. Ventro-lateral margin medially swollen, overhanging the ventral surface in lateral view. Ventral margin incurved antero-medially. Greatest length of carapace passes through mid-point with both the greatest length and width median. Shell surface very finely punctate with widely spaced normal pore canals prominent. Ventral surface of carapace weakly ridged. A low swelling below the anterior cardinal angle may represent an **eye swelling**. Left valve overlaps the right along the ventral margin but diverges away from the right as it approaches the anterior where there is no overlap. Posteriorly, however, the overlap by the left valve continues round to the posterior cardinal angle. Dorsally the left valve over-reaches the right. **Hinge** antimerodont. Left valve with elongate loculate terminal sockets and a long, denticulate median bar, above which there is a shallow accommodation groove. Right valve with 7 posterior teeth and 6 anterior teeth. All the teeth are dorsally bifid. Median groove locellate. **Inner margin** and **line of concrescence** coincide, the **duplicature** being rather narrow. **Radial pore canals** short and thick, widely spaced; 8 anteriorly, 4 posteriorly. **Muscle scars** of type **A**, situated fairly low down in the anterior part of the carapace. The 4 adductor scars are situated in a subvertical row with the most dorsal scar being slightly offset to the anterior. Antennal scar large, round and antero-dorsal in position. The round mandibular scar has an antero-ventral position.

DIMENSIONS. Holotype. Io.2582, carapace, length 0·60 mm.; height 0·41 mm.; width 0·33 mm.

Paratypes. Io.2583, carapace, length 0·64 mm.; height 0·44 mm.; width 0·34 mm. Io.2584, left valve, length 0·64 mm.; height 0·43 mm. Io.2585, left valve, length 0·56 mm.; height 0·38 mm. Io.2586, right valve, length 0·49 mm.; height 0·32 mm.

REMARKS. *Micropneumatocythere postrotunda* sp. nov. is easily distinguishable from all other species of the genus by its well rounded somewhat flattened posterior and blunt, narrower anterior. Dimorphism has not been observed for this species.

Micropneumatocythere quadrata sp. nov.

(Pl. 19, figs. 11, 12, Pl. 20, figs. 1–12.)

DIAGNOSIS. *Micropneumatocythere*, with sub-quadrate rather deep carapace (elongate in male dimorph); cardinal angles prominent, especially posterior angle. Postero-dorsal slope steeply angled; postero-ventral slope characteristically broad,

deep, strongly convex. Shell surface punctate with widely spaced, large, normal pore canals. Internal details as for genus.

HOLOTYPE. Io.2592, female carapace, bed P, Kings Cliffe.

PARATYPES. Io.2593–2606, male and female carapaces and single valves from beds F, O, P, R & S, Kings Cliffe.

DESCRIPTION. **Carapace** subquadrate with high, arched dorsal outline in the female dimorph, elongate in the male. Cardinal angles especially the posterior angle sharply defined, the anterior angle in the left valve is, however, broadly rounded. Anterior broadly rounded, posterior triangular and slightly upturned at extremity. Dorsal margin more strongly convex in the left valve than in the right. Antero-dorsal slope broadly convex; postero-dorsal slope steep, slightly concave in the left valve but more strongly so in the right. Postero-ventral slope broadly convex. Ventral margin antero medially incurved. Ventro-lateral margin typically swollen and overhanging the ventral surface in lateral view. Posterior border compressed at extremity. Greatest length of carapace passes through mid-point, whilst both greatest height and width are median. Shell surface finely punctate, over which large **normal pore canal** openings are scattered. Ventral surface with 4–5 longitudinal ridges per valve. Left valve larger than the right which it overlaps along the ventral margin except medially where a small section of the right valve slightly overlaps the left. Around the anterior and along the antero-, and postero-dorsal slopes the left valve slightly over-reaches the right. Mid-dorsally, however, the over-reach of the right valve by the left is very strong, the elongate, triangular accommodation groove of the left valve being completely visible. **Hinge** anti-merodont. Left valve with elongate, loculate terminal sockets, a strong, dentate median bar and an elongate triangular accommodation groove. Right valve with 6 (dorsally bifid) anterior teeth and 7, also bifid, posterior teeth. Median groove loculate. **Inner margin** and **line of concrescence** coincide; **duplicature** of moderate width. **Radial pore canals** few in number, widely spaced and tend to widen towards the inner margin. 7–8 anteriorly; approximately 3 posteriorly. **Muscle scars** not observed.

DIMENSIONS. Holotype. Io.2592, female carapace, length 0·56 mm.; height 0·39 mm.; width 0·35 mm.

Paratypes. Io.2593, male carapace, length 0·68 mm.; height 0·41 mm.; width 0·37 mm. Io.2594, female right valve, length 0·61 mm.; height 0·38 mm. Io.2595, female left valve, length 0·55 mm.; height 0·40 mm. Io.2596, female carapace, length 0·56 mm.; height 0·41 mm.; width 0·37 mm.

REMARKS. *Micropneumatocythere quadrata* sp. nov. is distinguished from all other species of the genus by the sharply angled posterior cardinal angle coupled with the broad, deep, postero-ventral slope. Although tending to vary with individuals, the left valve rather more strongly overreaches the right valve than is usual for the genus.

Micropneumatocythere subconcentrica (Jones)

(Pl. 21, figs. 1–13)

1884 *Cythere subconcentrica* Jones : 768, pl. 34, figs. 28, 29.

Diagnosis. *Micropneumatocythere* with oval carapace, tapering to posterior. Ventro-lateral margin swollen. Shell surface punctate laterally. Ventral surface with longitudinal ridges extending onto ventro-lateral margin and turning upwards anteriorly and posteriorly. Internal details as for genus.

Lectotype. Selected here. In.43505, left valve, Great Oolite; Richmond boring at depth of 1,151 ft. 6 in. figured Jones 1884, pl. 34, fig. 28. Although Jones refers to his fig. 28 as being of a right valve, the illustration appears to be a left valve. Specimen In.43505 is considered to be the one illustrated.

Other material. Io.2606–12, carapace and single valves from bed F, Kings Cliffe and bed H, Ketton.

Description. **Carapace** ovoid with arched dorsal outline and rounded cardinal angles. Posterior tapering, slightly rounded with concave postero-dorsal slope and convex postero-ventral slope. Ventro-lateral margin swollen projecting below ventral surface in side view. Anterior rounded. Ventral margin antero-medially incurved. Line of greatest length passes through mid-point, greatest height and width median. Shell surface laterally punctate, ventrally ridged, the ridges passing onto the ventro-lateral margin and sub-concentrically turn upwards anteriorly and posteriorly. This rather weak ornamentation rapidly dies out upwards. **Normal pore canals** are widely spaced over the carapace, their openings being rather large and circular. Left valve larger than the right which it overlaps along the ventral margin except for a small median section where the right valve overlaps the left. Dorsally the left valve over-reaches the right. **Hinge** antimerodont. Left valve with elongate, loculate, terminal sockets, a denticulate median bar and a deepish accommodation groove. Right valve with approximately 5–6 terminal teeth and a long, delicate, locellate groove. **Muscle scars** of type **A**, the small, round, antennal scar having an antero-dorsal position. **Inner margin** coincides with the **line of concrescence** apart from antero-medially where a very narrow **vestibule** may be present, but not in all cases. **Radial pore canals** few in number, straight and widely spread, 7 anteriorly, 3 posteriorly. A narrow **flange** may be preserved around the anterior margin but as this is a very delicate structure it is usually lost.

Dimensions. Lectotype. IN.43505, left valve, length 0·56 mm.; height 0·38 mm. Other material. Io.2607, carapace, length 0·57 mm.; height 0·37 mm.; width 0·32 mm. Io.2608, left valve, length 0·51 mm.; height 0·34 mm. Io.2609, right valve, length 0·49 mm.; height 0·30 mm. Io.2610, left valve, length 0·50 mm.; height 0·34 mm.

Remarks. *Micropneumatocythere subconcentrica* (Jones) resembles *M. globosa* Bate (1964 : 12) in outline but differs in being a much larger species and in having

a more prominent ornamentation of ridges on the ventro-lateral margin. Dimorphism has not been observed for *M. subconcentrica* although it is well developed in *M. globosa*. The close similarity of the two species suggests, however, that the present species is a descendant of *M. globosa*.

Family **TRACHYLEBERIDIDAE** Sylvester-Bradley 1948

Subfamily **TRACHYLEBERIDINAE** Sylvester-Bradley 1948

Genus ***OLIGOCYTHEREIS*** Sylvester-Bradley 1948

Oligocythereis fullonica (Jones & Sherborn)

(Pl. 21, figs. 14, 15)

1888 *Cytheris fullonica* Jones & Sherborn : 256, pl. 4, fig. 13*a–c*.
1948 *Cythereis* cf. *fullonica* Jones & Sherborn ; Sylvester-Bradley : 186, pl. 12, figs. 7–10 ; pl. 13, figs. 3, 9.
1948*a* *Oligocythereis fullonica* (Jones & Sherborn) Sylvester-Bradley : 796, pl. 122, figs. 1–6.
1962 *Oligocythereis* cf. *fullonica* (Jones & Sherborn) ; Brand & Fahrion : 150, pl. 21, fig. 27.
1963 *Oligocythereis fullonica* (Jones & Sherborn) ; Oertli : 41, pl. 25 fig. *a*, pl. 26, fig. *a*.

Remarks. Only two specimens of this species have been found within the Estuarine Series and these occur in the Ancaster bed W (possibly Gt. Oolite), and Dane Hill sections. Both are ornamentally different. Sylvester-Bradley (1948 : 187) records three varieties within the species but did not have sufficient material to determine whether this was of systematic significance. The same is true here.

Family Uncertain.

Genus ***PLATYCYTHERE*** nov.

Diagnosis. Cytheracea with subquadrate to subrectangular carapace, laterally flattened with thickened overhanging dorsal and ventral areas. Dorsal and ventral surfaces flattened. In dorsal view parallel sided or slightly diverging to venter. Ornamentation strongly to weakly reticulate. Left valve very slightly larger than right. Hinge entomodont, muscle scars type **A**. Inner margin and line of concrescence coincide. Radial pore canals straight, few, widely spaced; 8 anteriorly, 3 posteriorly. Normal pore canals large, few, widely and irregularly scattered over carapace.

Type species. *Platycythere verriculata* sp. nov.

Remarks. Although possessing characters which identify the genus as belonging to the Cytheracea it is not possible at this stage to place it in any known family. The unusually flattened carapace, provides only a narrow internal space for the animal when closed, whilst the swollen dorsal and ventral parts of the carapace might have had a functional use such as acting as stabilizers whilst crawling over bottom sediment.

Platycythere verriculata sp. nov.

(Pl. 22, figs. 1–13)

Diagnosis. *Platycythere* with subquadrate/subrectangular carapace flattened laterally in dorsal view. Ventro-lateral and dorso-lateral margins swollen, projecting beyond lateral surface. Dorsal and ventral surfaces also flattened. Shell surface coarsely reticulate with smooth marginal border in male dimorph, tending to be smooth entirely in juvenile instars and in female dimorph, although some ornamentation usually observed in region of dorsal and ventral swellings. Ventral surface ornamented with longitudinal ridges in both dimorphs. Internal details as for genus.

Holotype. Io.2613, male carapace bed J, Kettering.

Paratypes. Io.2614–22, female and juvenile carapaces and male valves, beds A, G & J, Kettering and bed N, Kings Cliffe.

Description. **Carapace** subquadrate in the female dimorph, elongate, subrectangular in the male. Carapace typically flattened in dorsal view, the sides being parallel in the male but tending to slope outwards towards the venter in the female. Ventro-lateral and dorso-lateral margins swollen, projecting beyond the lateral surface when viewed dorsally. Dorsal and ventral surfaces flattened. The female carapace tapers towards the posterior, whilst the male tends to have dorsal and ventral margins almost parallel. Anterior broadly rounded, posterior rounded, but more narrowly so. The ventral margin has only a very shallow antero-median incurvature; dorsal margin almost straight sloping gently or strongly towards the posterior depending upon the dimorph. Greatest length of carapace extends through mid-point whilst greatest height is approximately median in the female and either at the anterior cardinal angle or just behind middle in the male. Greatest width possibly through middle of carapace in the female, whilst in the male the parallel lateral margins give no point at which the carapace is widest. Shell surface coarsely reticulate in the male dimorph, the reticulations tending to die out towards the anterior and posterior so that an unornamented border is apparent. In the female dimorph and in juvenile instars there is almost no trace of the reticulate ornamentation save in the region of the ventral and dorsal swellings. Ventral surface ornamented with 5–6 longitudinal ridges per valve in both dimorphs. **Normal pore canals** very widely and irregularly scattered over the carapace, few in number and rather large, circular or almost hexagonal in outline. Left valve slightly overlaps the right at the cardinal angles and, particularly in the female slightly projects beyond the right around the anterior and posterior. Ventrally the two valves have neither overlap nor overreach. **Hinge** entomodont. Left valve with elongate terminal sockets, presumably loculate but infilled with matrix, and a long denticulate median bar, the anterior portion of which is very coarsely dentate. No accommodation groove. Right valve with 6 strong anterior teeth and 5 much smaller and weaker posterior teeth. Median groove loculate, expanded and more coarsely loculate in its anterior portion. **Muscle scars** of type **A**, the four small

adductor scars arranged in a slightly crescentic row with the small, round, antennal scar positioned antero-dorsally. Antero-ventrally the mandibular scar is also rounded and is very much larger than those previously described. **Inner margin** and **line of concrescence** coincide; **duplicature** of moderate width, **radial pore canals** straight, few in number and widely spaced, 8 anteriorly and 3 posteriorly.

Dimensions. Holotype. Io.2613, male carapace, length 0·67 mm.; height 0·37 mm.; width 0·30 mm.

Paratypes. Io.2614, male right valve, length 0·66 mm.; height 0·37 mm. Io.2615, male right valve, length 0·54 mm.; height 0·31 mm. Io·2616, male left valve, length 0·66 mm.; height 0·37 mm. Io.2621, female carapace, length 0·60 mm.; height 0·37 mm.; width 0·26 mm. Io.2622, juvenile carapace, length 0·47 mm.; height 0·30 mm.; width 0·19 mm.

Remarks. *Platycythere verriculata* sp. nov. is quite unlike any previously described species and belongs to a distinct genus. The variation present within the species with regard to the ornamentation could suggest the presence of two distinct species. However, the outline of the smooth species suggests that the most probable explanation is that this is the female dimorph, the smaller juvenile instars being similarly without ornamentation. Only in the more elongate male dimorph is the reticulate ornamentation strongly developed over the lateral surface.

The width measurements given above are for the carapace excluding the swollen dorsal and ventral parts and are taken at valve centre.

III. PALAEOECOLOGY

The work undertaken by Aslin has shown there to be a variable and alternating succession of both marine and freshwater sediments exposed along the entire outcrop of the Upper Estuarine Series. The study of the ostracod faunas is, therefore, doubly interesting in that the stratigraphy of the succession has been examined in some detail.

The base of the Upper Estuarine Series is dominated by purplish grey clays with plant remains representing a continental period of deposition. The absence of ostracods from these beds and from the freshwater horizons which return from time to time throughout the succession is almost certainly due to decalcification. The marine horizons are more strongly calcified and contain a good macro- and microfauna, the evidence of which suggests deposition close to land and influenced by river effluent. As such both brackish water and marine ostracods are encountered. Completely freshwater faunas are probably not encountered for the reasons mentioned above, although faunas of low salinity are recorded and represent ostracod populations living some distance upstream from a river mouth or in a more static back swamp body of water. These low salinity populations are represented by the following species: *Darwinula incurva, Bisulcocypris ancasterensis, Belekocytheridea punctata* and *Macrodentina* (*Mediodentina*) *bathonica* at Ancaster, and at Kings Cliffe by *Darwinula incurva, Bisulcocypris anglica, Klieana levis, Macrodentina* (*Mediodentina*) *bathonica* and *Micropneumatocythere postrotunda*. Both populations are found

associated with freshwater-brackish-water charophytes. The two species of *Bisulcocypris* together with *Darwinula incurva* are considered to represent freshwater-oligohaline ostracods whilst the species of *Klieana*, *Macrodentina*, *Belekocytheridea* and *Micropneumatocythere* are considered to be euryhaline and found more typically in brackish water assemblages.

The evidence in support of the freshwater-oligohaline habit of the species mentioned above is as follows:

Firstly, the sediments in which the ostracods were found occur in that part of the rythmic sequence which is subject to the greatest freshwater influence.

Secondly, the ostracod population is restricted in the number of species present and lacks the normal marine ostracods (e.g. *Lophocythere* and *Progonocythere*).

Thirdly, the reported occurrence elsewhere of the ostracod genera concerned by other authors substantiates the findings here. For example *Klieana levis* Oertli (1957 : 760) was originally described from lacustrine sediments from Poitou in France whilst Van Morkhoven (1963 : 268) records the environmental range of the genus as being from fresh to brackish water. *Darwinula* is an essentially freshwater genus with some species ranging into brackish water. The type species, *Darwinula stephensoni* (Brady & Robertson 1870) is living at the present time in rivers and lakes in East Anglia from which area it was originally described. Van Morkhoven (1963 : 29) and Moore (1961 : Q254) give the ecological range of the genus as fresh-brackish water. The genus *Bisulcocypris* is regarded by Pinto & Sanguinetti (1962 : 75) as being typically freshwater. Malz in his excellent work on the genus *Macrodentina* gives the ecological habit of each of the subgenera comprising the genus as being either marine or marine to brackish. The new subgenus *Mediodentina* is considered to have a wide range from marine through brackish to almost freshwater conditions.

In at least two horizons in the Kettering section mixed assemblages of truly marine ostracods such as *Lophocythere scabra*; *Pichottia magnamuris*, *Marslatourella bullata* and *Schuleridea* (*Eoschuleridea*) *bathonica* are found associated with the euryhaline species of *Klieana* and *Macrodentina* and the oligohaline species of *Bisulcocypris* and *Darwinula*. This is not a typical assemblage and results either through the action of rivers bringing into the area ostracods which normally inhabit waters of lower salinity or as is more likely in this case, transgression of marine conditions results in the mixing of faunas, the low salinity ostracods being killed but preserved in the sediments deposited.

The euryhaline ostracods present in the Upper Estuarine Series have been mentioned already but in addition to these a number of normally marine species may also be found under brackish conditions. These are: *Glyptocythere guembeliana*; *Platycythere verriculata* and the two remaining species of *Micropneumatocythere*.

As has been suggested above regions of deposition where periods of marine transgression are common are liable to produce mixed assemblages. Blurring of boundaries between freshwater, brackish water and marine conditions is normal and results in mixing of faunas to some extent. There are, however, four ways in which mixing of ostracod faunas may result.

1. Normal mixing at the boundaries of salinity zones.
2. Freshwater species brought into brackish or marine conditions by rivers.
3. Transgression of the sea flooding bodies of freshwater and bringing marine ostracods into the area.
4. Reworking of sediments whether marine or freshwater and the redeposition of the ostracods present. Thus part of the ostracod fauna would be allochthonous and part autochthonous.

It is more than likely that all four variables have been operative during the deposition of the Upper Estuarine Series.

The ostracod species which appear to be most truly marine throughout are: *Paracypris terraefullonica*; *Monoceratina scarboroughensis*; *Galliaecytheridea? kingscliffensis*; *Pichottia magnamuris*; *Schuleridea* (*Eoschuleridea*) *bathonica*; *Praeschuleridea quadrata*; *Metacytheropteron drupacea*; *Progonocythere levigata*; *P. rugosa* and *P. triquetra*; *Glyptocythere juglandica*; *Lophocythere scabra*; *L. septicostata* and *L. transversiplicata*; *Marslatourella bullata* and *Oligocythereis fullonica*. All the ostracods mentioned as occurring in brackish waters also are found associated with the more restricted marine species listed above. Only *Macrodentina* (*Mediodentina*) *bathonica*, *Belekocytheridea punctata* and *Klieana levis* are to be found in all associations.

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PLATE 1

Paracypris terraefullonica (Jones & Sherborn) p. 27

FIG. 1. Internal view, right valve. Io.2251. ×85.
FIG. 2. External view, left valve. Lectotype, I.1875. ×85.
FIG. 3. External view, right valve. I.1874. ×85.
FIGS. 4–6. Right, dorsal and ventral views, complete carapace. Io.2250. ×85.

Darwinula incurva sp. nov. p. 28

FIG. 7. External view of crushed specimen, left side, showing muscle scars. Paratype, Io.2274. ×70.
FIG. 8. Muscle scars. Paratype, Io.2274. ×180.
FIG. 9. Internal view of left valve showing denticulate ventral margin. Paratype, Io.2261. ×70.
FIGS. 10–12. Ventral, left and right views, complete carapace. Holotype, Io.2259. ×70.

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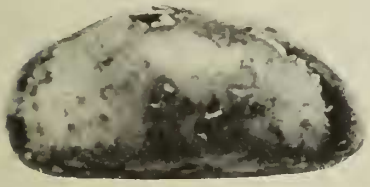

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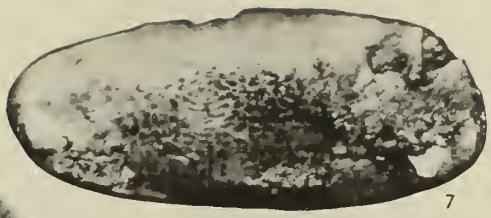

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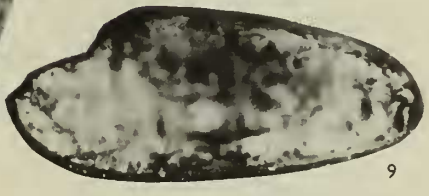

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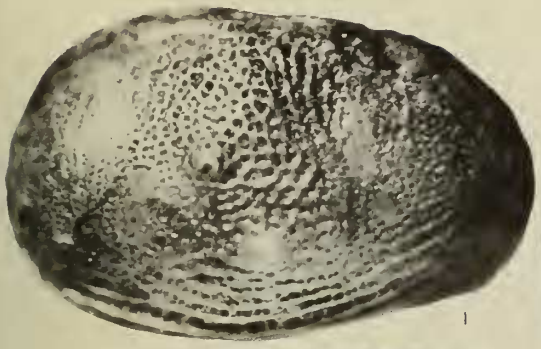
PLATE 2

Bisulcocypris anglica sp. nov. p. 30

FIGS. 1–4. Right, left, ventral and dorsal views, male paratype. Io.2277. ×70.
FIGS. 5–7. Dorsal, right and left views, female holotype. Io.2275. ×70.
FIGS. 8–11. Left, right, dorsal and ventral views, juvenile paratype. Io.2280. ×70.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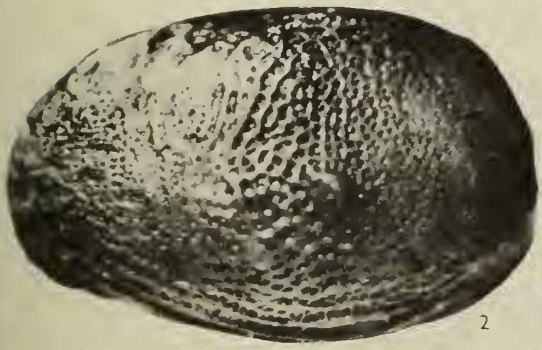
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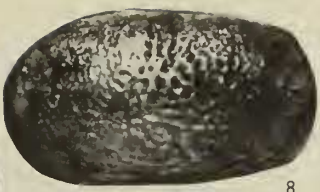
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PLATE 3

Bisulcocypris ancasterensis sp. nov. p. 32

FIGS. 1–3. Left, right and dorsal views, female holotype. Io.2282. ×70.
FIGS. 4–6. Left, right and ventral views, male paratype. Io.2284. ×70.
FIGS. 7–10. Right, left, dorsal and ventral views, juvenile paratype. Io.2285. ×70.

Monoceratina scarboroughensis Bate p. 33

FIG. 11. Right view, female carapace. Io.2302. ×85.


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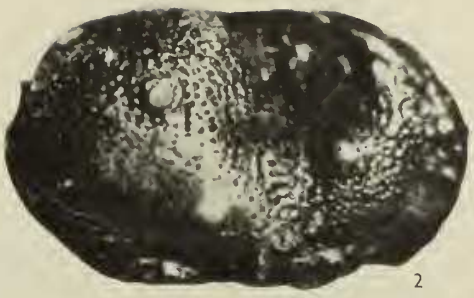
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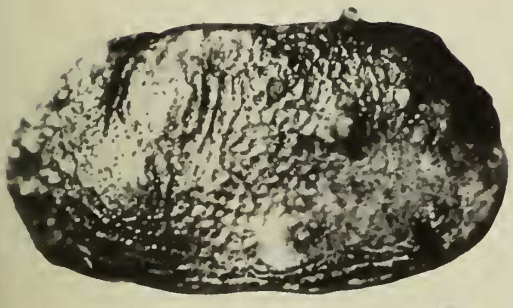
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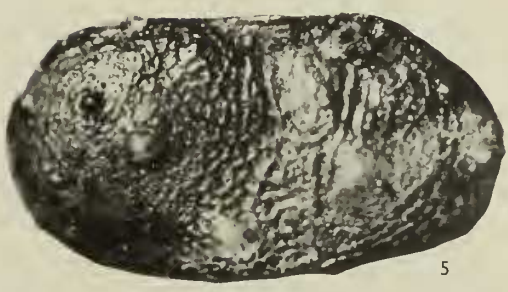
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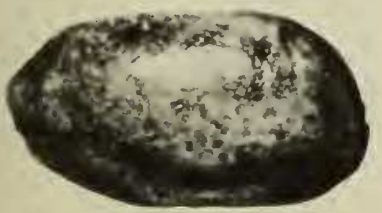
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PLATE 4

Fabanella bathonica (Oertli) p. 33

FIG. 1. Internal view, female left valve to show radial pore canals. Io.2305. ×70.
FIGS. 2, 3. External and internal views, male right valve. Io.2303. ×70.
FIGS. 4, 5. Internal and external views, female left valve. Io.2304. ×70.

Galliaecytheridea? kingscliffensis sp. nov. p. 34

FIGS. 6, 7. Right and left views, female carapace. Holotype, Io.2316. ×80.
FIG. 8. Dorsal view of hinge, male left valve. Paratype, Io.2322. ×100.
FIG. 9. Internal view, female left valve. Paratype, Io.2321. ×80.
FIG. 10. Dorsal view showing median bar of hinge, female left valve. Paratype, Io.2321. ×100.
FIG. 11. Internal view, female right valve. Paratype, Io.2326. ×85.
FIG. 12. Muscle scars, female right valve. Paratype, Io.2326. ×250.

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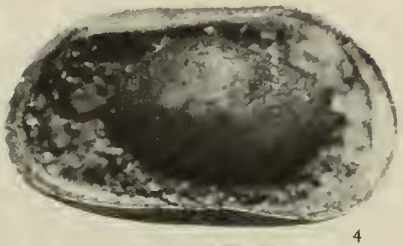

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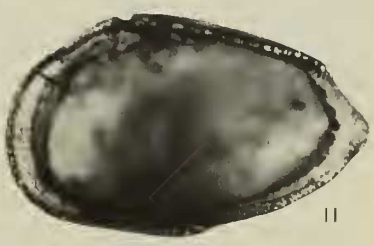

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PLATE 5

Galliaecytheridea*? *kingscliffensis sp. nov. p. 34

FIG. 1. Internal view to show radial pore canals, female left valve. Paratype, Io.2321. ×85.

FIGS. 2, 3. Dorsal and ventral views, female carapace. Holotype, Io.2316. ×80.

FIG. 4. External view, female left valve. Paratype, Io.2321. ×85.

FIGS. 5–8. Left, right, dorsal and ventral views, male carapace. Paratype, Io.2318. ×80.

Belekocytheridea punctata gen. et sp. nov. p. 36

FIGS. 9–12. Left, right, dorsal and ventral views female carapace. Holotype, Io.2328. ×85.

FIG. 13. Right side showing muscle scars, female carapace. Paratype, Io.2331. ×85.


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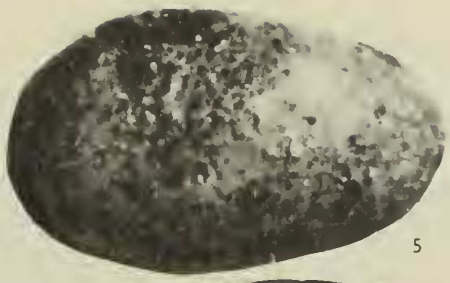
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PLATE 6

Belekocytheridea punctata gen. et sp. nov. p. 36

FIGS. 1–4. Left, right, dorsal and ventral views, male carapace. Paratype, Io.2329. ×85.

FIG. 5. Internal view, female left valve. Paratype, Io.2357. ×85.

Pichottia magnamuris sp. nov. p. 38

FIGS. 6–9. Left, right, dorsal and ventral views, female carapace. Holotype, Io.2358. ×85.

FIG. 10. Dorsal view to show median hinge bar, male left valve. Paratype, Io.2366. ×100.

FIG. 11. Dorsal view of hinge, female left valve. Paratype, Io.2362. ×100.

FIG. 12. Dorsal view of hinge, female right valve. Paratype, Io.2363. ×100.

FIG. 13. Internal view to show radial pore canals, male right valve. Paratype, Io.2367. ×100.

FIG. 14. Muscle scars, male left valve. Paratype, Io.2368. ×180.


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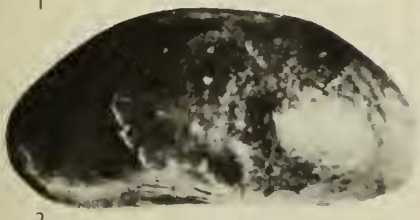
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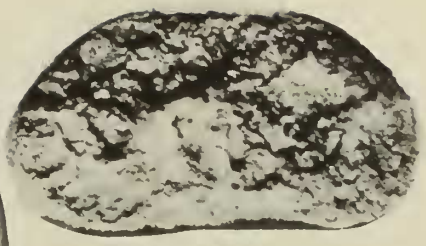
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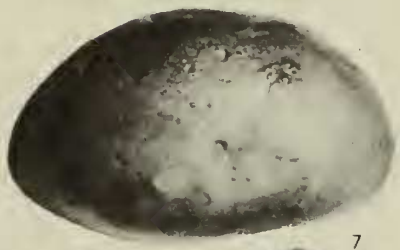
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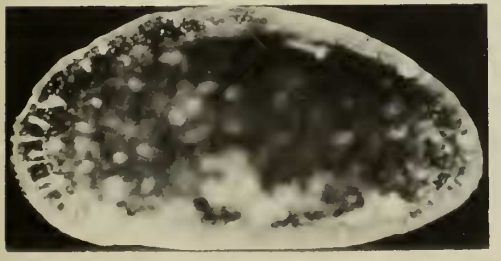
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PLATE 7

Pichottia magnamuris sp. nov. p. 38

FIGS. 1–4. Left, right, ventral and dorsal views, male carapace. Paratype, Io.2360. ×85.

FIG. 5. Internal view, female right valve. Paratype, Io.2363. ×85.

FIG. 6. Internal view, female left valve. Paratype, Io.2362. ×85.

Schuleridea (Eoschuleridea) bathonica subgen. et sp. nov. p. 41

FIGS. 7–10. Left, right, dorsal and ventral views, female carapace. Holotype, Io.2369. ×85.

FIG. 11. Dorsal view of hinge, female right valve. Paratype, Io.2376. ×100.

FIGS. 12, 13. Female right valve showing radial pore canals. Fig. 12 ×160, fig. 13 ×85. Paratype, Io.2373.


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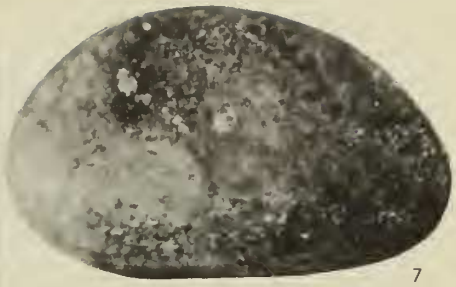
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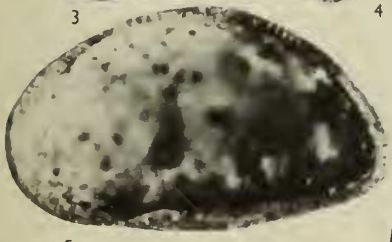
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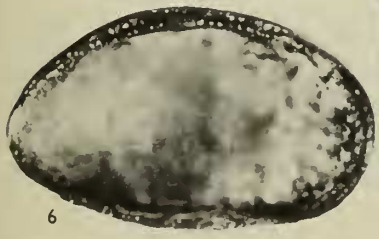
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PLATE 8

Schuleridea* (*Eoschuleridea*) *bathonica subgen. et sp. nov. p. 41

FIG. 1. Internal view to show hinge, female right valve. Paratype, Io.2373. ×100.
FIGS. 2, 3. External and internal views, male left valve. Paratype, Io.2379. ×85.
FIGS. 4, 5. Internal and external views, female left valve. Paratype, Io.2375. ×85.
FIGS. 6, 7. External and internal views, female right valve. Paratype, Io.2376. ×85.
FIGS. 8–10. Dorsal, right and ventral views, male carapace. Paratype, Io.2370. ×85.
FIG. 11. Muscle scars, note large size of antennal scar, male left valve. Paratype, Io.2378. ×300.

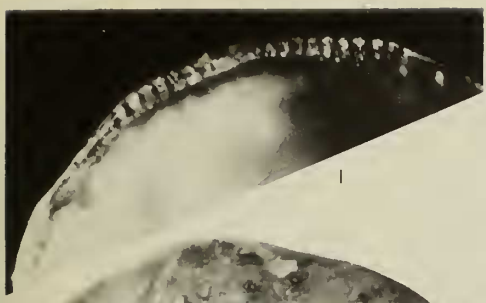
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PLATE 9

Praeschuleridea quadrata sp. nov. p. 42

FIGS. 1–4. Right, left, dorsal and ventral views, female carapace. Holotype, Io.2395. ×85.

FIGS. 5–7. Dorsal view (×100), external and internal views, female right valve. Paratype, Io.2399. ×85.

FIGS. 8, 9. Internal views to show radial pore canals and hinge, female left valve. Paratype, Io.2398. ×85.

FIGS. 10, 11. Left and dorsal views, male carapace. Paratype, Io.2397. ×85.

FIG. 12. Muscle scars, male left valve. Paratype, Io.2400. ×300.


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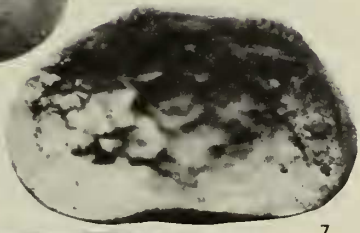
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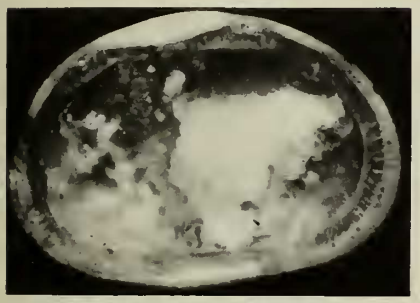
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PLATE 10

Metacytheropteron drupacea (Jones) p. 44

FIGS. 1, 2. External view and internal view showing radial pore canals, male left valve. Io.2415. ×85.

FIGS. 3, 4. Left and right views, female carapace. Jones' original specimen, holotype, IN.43498. ×85.

FIGS. 5, 7. External and internal views, female left valve. Io.2414. ×85.

FIGS. 6, 8, 9. Internal and external views, ×85, and dorsal view, ×100, male right valve. Io.2416.

Progonocythere levigata sp. nov. p. 45

FIG. 10. Dorsal view of hinge to show terminal teeth and plate-like extension of the anterior portion of the median groove. Female right valve. Paratype, Io.2420. ×100.

FIGS. 11, 12. External and internal views, female left valve. Holotype, Io.2419. ×70.

FIG. 13. Muscle scars of holotype, Io.2419. ×170.

FIG. 14. Internal view, female right valve. Paratype, Io.2420. ×70.


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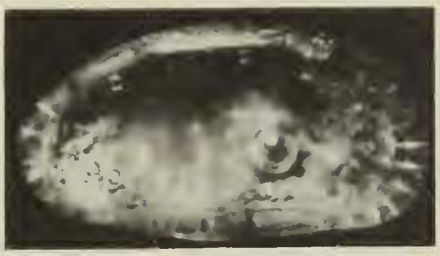
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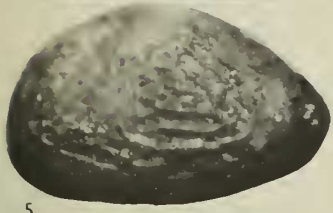
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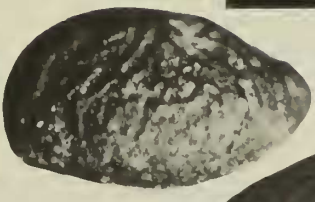
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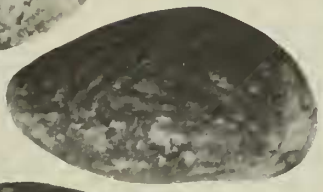
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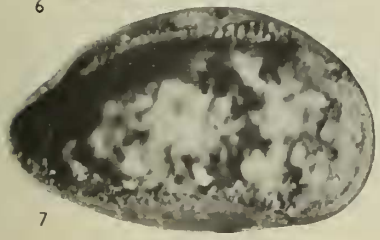
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PLATE 11

Progonocythere levigata sp. nov. p. 45

FIG. 1. Internal view, male right valve. Paratype, Io.2422. ×70.

FIGS. 2–4. External and internal views, ×70, and muscle scars, ×310, male left valve. Paratype, Io.2421.

FIGS. 5–8. Dorsal, ventral, left and right views, female carapace. Paratype, Io.2423. ×70.

FIG. 9. External view, female right valve. Paratype, Io.2420. ×70.

Progonocythere rugosa sp. nov. p. 46

FIGS. 10–13. Right, left, dorsal and ventral views, female carapace. Holotype, Io.2434. ×70.

FIG. 14. Dorsal view, female right valve. Paratype, Io.2438. ×100.


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PLATE 12

Progonocythere rugosa sp. nov. p. 46

FIGS. 1–4. Left, right, dorsal and ventral views, male carapace. Paratype, Io.2435, ×70.
FIGS. 5, 7, 9. Internal views to show radial pore canals and hinge, ×70, and muscle scars, ×350, male left valve. Paratype, Io.2437. ×70.
FIGS. 6, 8. External and internal views, female right valve. Paratype, Io.2438. ×70.

Progonocythere triquetra sp. nov. p. 48

FIGS. 10–13. Left, right, dorsal and ventral views, female carapace. Holotype, Io.2453. ×70.


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PLATE 13

Progonocythere rugosa sp. nov. p. 46

FIG. 2. Dorsal view, hinge, male left valve. Paratype, Io.2437. ×100.

Progonocythere triquetra sp. nov. p. 48

FIGS. 1, 5, 6. Dorsal view, ×100, and external and internal views, ×70, male left valve. Paratype, Io.2456.

FIGS. 3, 9. Dorsal view, ×100, and external view, ×70, female left valve. Paratype, Io.2454.

FIGS. 4, 7, 8. Dorsal view, ×100, and external and internal views, ×70, female right valve. Paratype, Io.2455.

Glyptocythere guembeliana (Jones) p. 49

FIG. 10. External view, male right valve. Lectotype, IN.43493. ×70.

FIG. 11. External view, male right valve. Io.2466. ×70.

FIG. 12. External view, female right valve, Jones & Sherborn's. *Cytheridea pulvinar*. I. 1858 ×70.

FIG. 13. Dorsal view of median hinge bar, male left valve. Io.2465.

FIGS. 14, 16. External and internal views, female left valve. Io.2467. ×70.

FIG. 15. Internal view, female right valve. Io.2469. ×70.

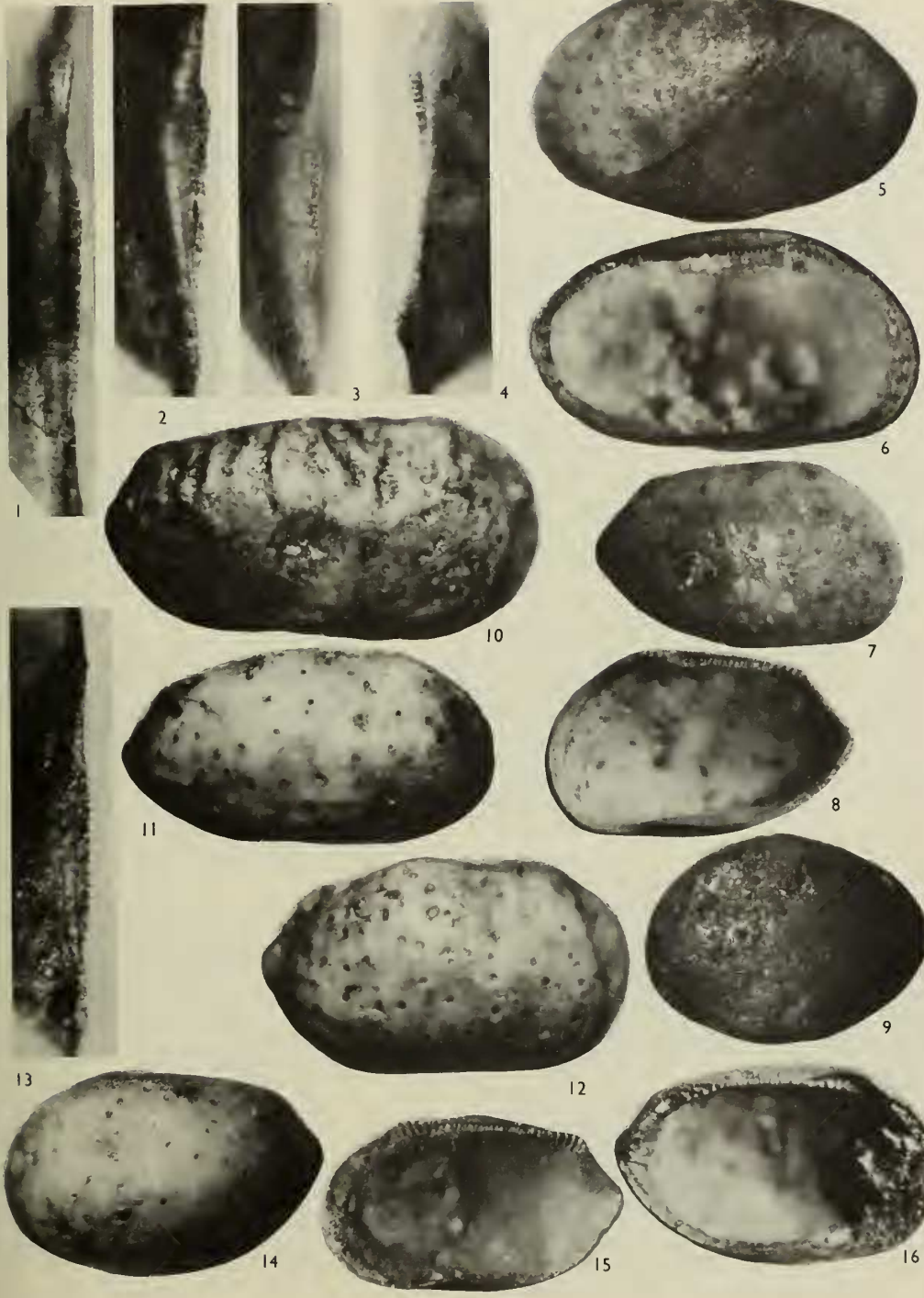
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PLATE 14

Glyptocythere guembeliana (Jones) p. 49

FIGS. 1, 5. External view showing ventral alate extension, and internal view, female right valve. Io.2472. ×70.

FIG. 2. External view of female right valve without alate extension. Io.2469. ×70.

FIGS. 3, 4. Dorsal and ventral views, female carapace. Io.2473. ×70.

FIGS. 6, 7. Internal view, female right valve showing radial pore canals. Fig. 6 ×150, fig. 7 ×70. Io.2468.

FIG. 8. Muscle scars ×360, female right valve. Io.2468.

Glyptocythere juglandica (Jones) p. 51

FIG. 9. Right side, male carapace. Io.2516. ×70.

Klieana levis Oertli p. 51

FIGS. 10, 11, 13. Left, right and ventral views, male carapace. Io.2522. ×85.

FIG. 12. Internal view showing hinge, female left valve. Io.2521. ×85.


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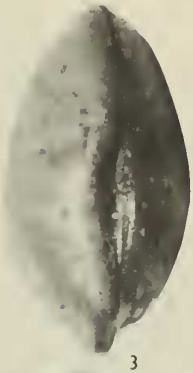
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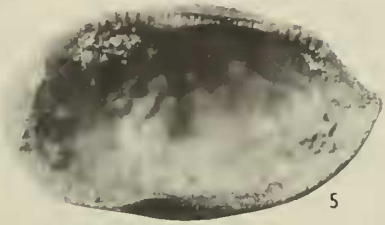
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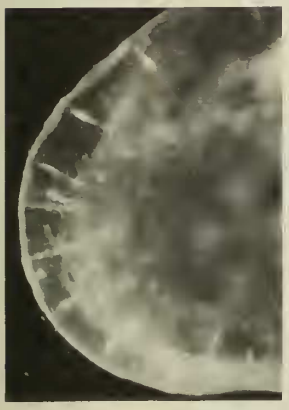
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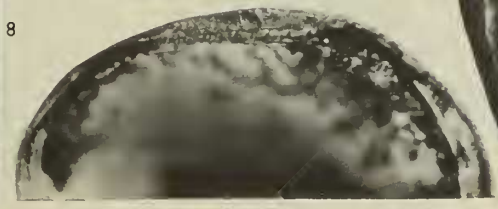
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PLATE 15

Klieana levis Oertli p. 51

FIG. 1. Internal view, female right valve, to show radial pore canals. Io.2520. ×85.
FIG. 2. Internal view, hinge, female right valve. Io.2520. ×100.
FIGS. 3, 4. Left and right views, female carapace. Io.2518. ×85.
FIG. 5. Muscle scars, female right valve. Io.2520. ×240.

Lophocythere scabra scabra Triebel p. 52

FIG. 6. External view, female right valve. Io.2539. ×85.

Lophocythere septicostata sp. nov. p. 52

FIGS. 7–10. Left, right, dorsal and ventral views, female carapace. Holotype, Io.2542. ×85.
FIGS. 11–13. Internal and external views, ×85, and dorsal view, ×100, female right valve. Paratype I.1843. This specimen was originally figured by Jones & Sherborn 1888 as *Cytheridea bradiana* (Jones).

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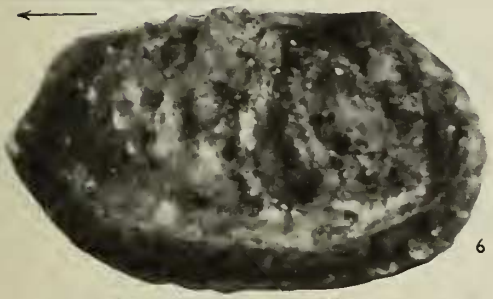

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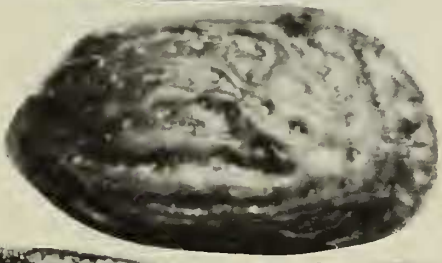

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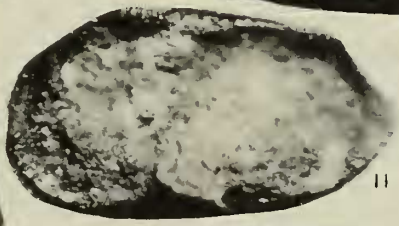

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PLATE 16

Lophocythere septicostata sp. nov. p. 52

FIGS. 1–4. Left, right, dorsal and ventral views, male carapace. Paratype, Io.2547. ×85.

Lophocythere transversiplicata sp. nov. p. 53

FIGS. 5–7. Left, right and dorsal views, male carapace. Paratype, Io.2626. ×85.

FIGS. 8–10. Left, dorsal and ventral views, female carapace. Holotype, Io.2625. ×85.

FIGS. 11, 12. Internal view, ×85, and dorsal view, ×100, female right valve. Paratype, Io.2627.

FIG. 13. External view, male right valve. Paratype, Io.2628. ×85.

FIG. 14. External view, male left valve. Paratype, Io.2629. ×85.

FIG. 15. Internal view showing radial pore canals, female right valve. Paratype, Io.2627. ×85.

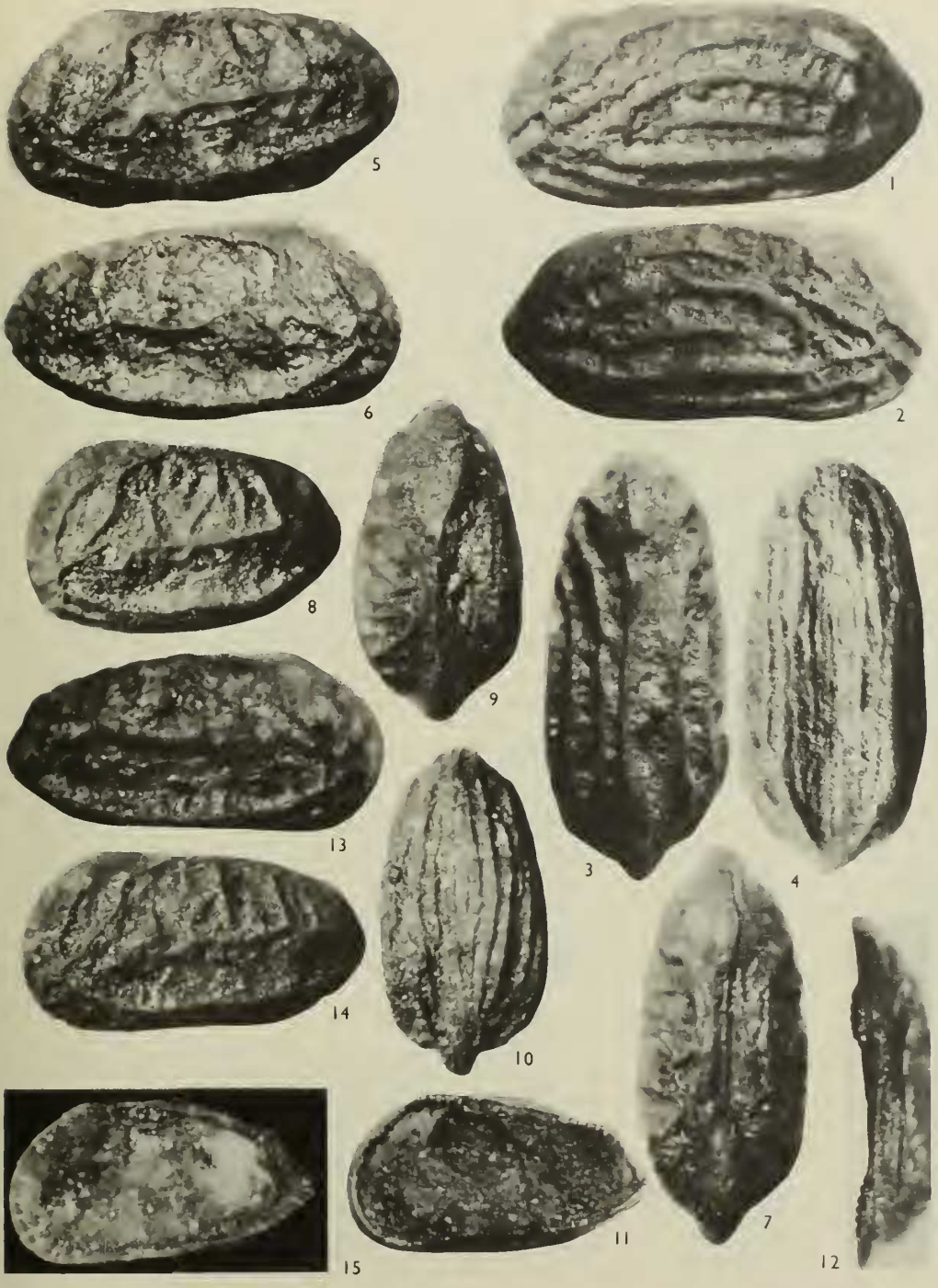
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PLATE 17

Macrodentina* (*Mediodentina*) *bathonica subgen. et sp. nov. p. 55

FIGS. 1–3. Left, right and ventral views, female carapace. Holotype, Io.2550. ×70.

FIGS. 4, 7, 12. External view (×70), internal and dorsal views of hinge (×100), female right valve. Note plate-like extension of the lower margin of the anterior part of the median groove in dorsal view. Paratype, Io.2556.

FIGS. 5, 6. External and internal views, female left valve. Paratype, Io.2554. ×70.

FIG. 8. Internal view showing radial pore canals, female right valve. Paratype, Io.2557. ×70.

FIG. 9. Internal view showing radial pore canals, male left valve. Paratype, Io.2552. ×70.

FIG. 10. Dorsal view showing median hinge bar, male left valve. Paratype, Io.2552. ×100.

FIG. 11. Dorsal view showing enlarged antero-median part of median bar, female left valve. Paratype, Io.2555. ×100.

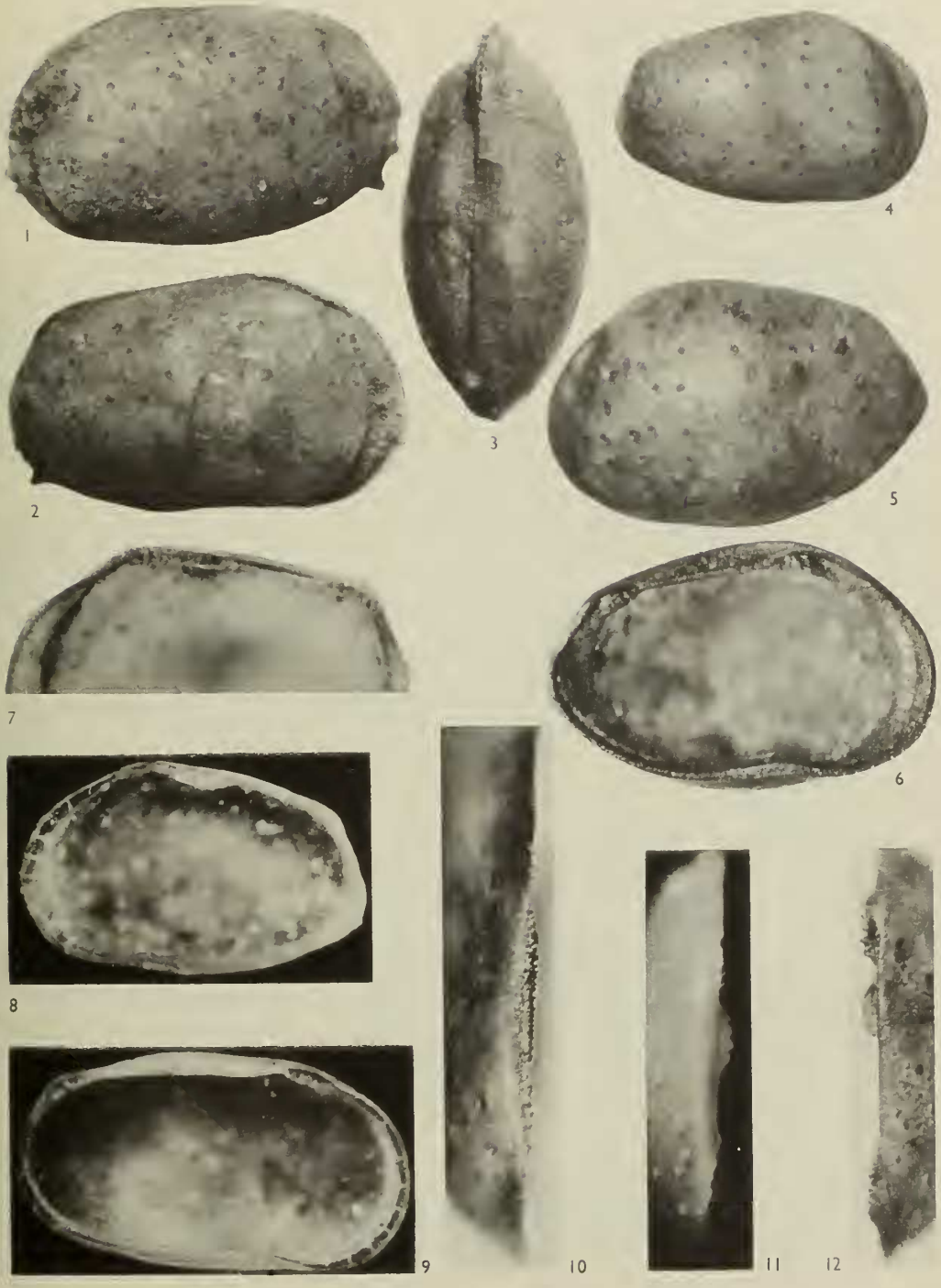
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PLATE 18

Macrodentina* (*Mediodentina*) *bathonica subgen. et sp. nov. p. 55

FIGS. 1, 4. External and internal views, male left valve. Paratype, Io.2552. ×70.

FIG. 2. External view to show strength of surface ornamentation in this specimen, masking the normal pore canals. Male left valve. Paratype, Io.2553. ×70.

FIG. 3. Muscle scars, female right valve. The dark ringed circles, including that showing a diagonal cross-bar, are normal pore canals. The mandibular scar is not shown in this illustration. Paratype, Io.2557. ×250.

Marslatourella bullata sp. nov. p. 56

FIGS. 5–8. Right, left, dorsal and ventral views, male carapace. Paratype, Io 2575×70.

FIGS. 9–12. Right, left, dorsal and ventral views, female carapace. Paratype, Io.2579. ×70.

FIG. 13. External view, female right valve. Holotype, Io.2573. ×70.

FIG. 14. Internal view of hinge, female left valve. Paratype, Io.2578. ×100.

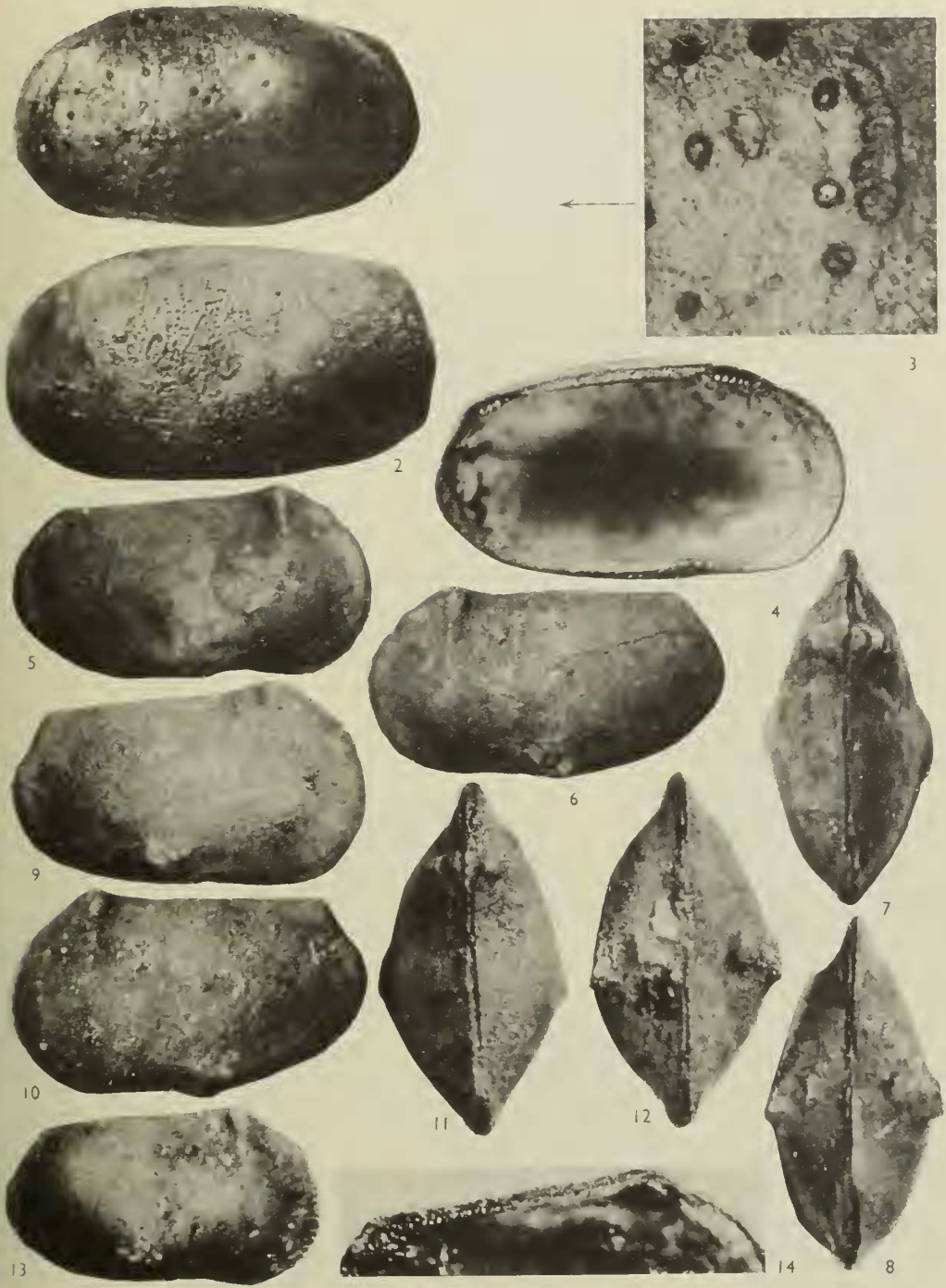
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PLATE 19

Marslatourella bullata sp. nov. p. 56

FIGS. 1, 2. Internal view showing radial pore canals and external view. Female left valve. Paratype, Io.2578. ×70.

Micropneumatocythere postrotunda sp. nov. p. 57

FIGS. 3–6. Left, right, dorsal and ventral views of carapace. Holotype, Io.2582. ×85.

FIGS. 7, 8, 13. Internal and external views (×85) and dorsal view (×100), left valve. Paratype, Io.2584.

FIGS. 9, 10, 14. External and internal views (×85) and dorsal view (×100), right valve. Paratype, Io.2586.

FIG. 15. Anterior radial pore canals, left valve. Paratype, Io.2585. ×160.

FIG. 16. Muscle scars, paratype, Io.2583. ×270.

Micropneumatocythere quadrata sp. nov. p. 58

FIGS. 11, 12. External and internal views, female left valve. Paratype, Io.2595. ×85.


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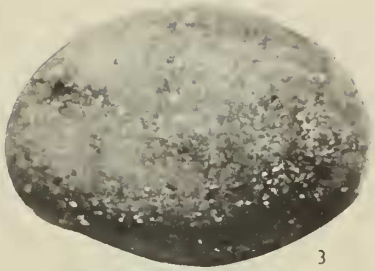
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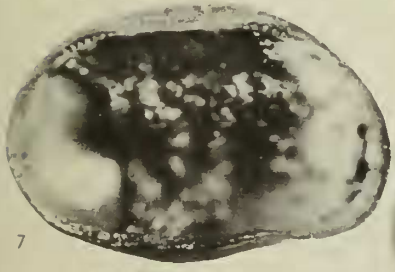
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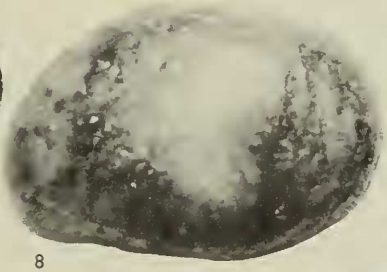
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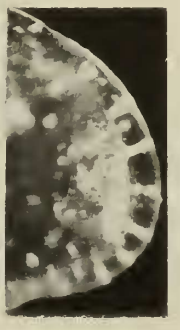
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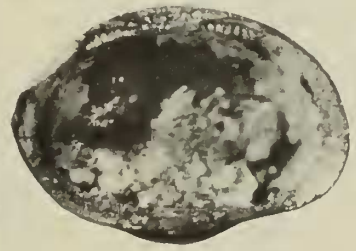
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PLATE 20

Micropneumatocythere quadrata sp. nov. p. 58

FIGS. 1–4. Left, right, dorsal and ventral views, female carapace. Holotype, Io.2592. ×85.

FIGS. 5–8. Left, dorsal, right and ventral views, male carapace. Paratype, Io.2593. ×85.

FIGS. 9, 10, 12. Internal and external views, ×85, dorsal view, ×100, female right valve. Paratype, Io.2594.

FIG. 11. Dorsal view, female left valve. Paratype, Io.2595. ×100.

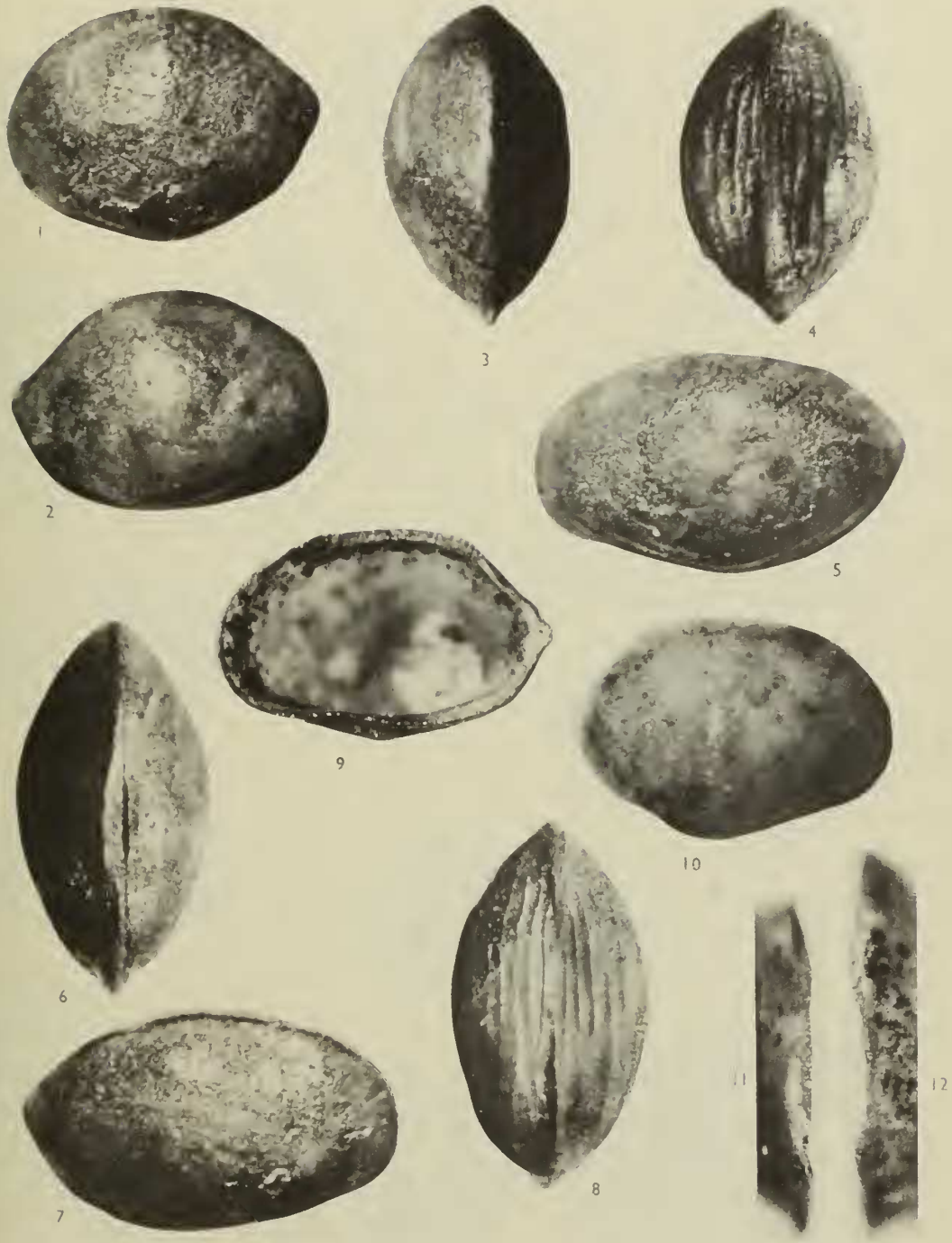
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PLATE 21

Micropneumatocythere subconcentrica (Jones) p. 60

FIGS. 1–4. Right, left, dorsal and ventral views, carapace. Io.2607. ×85.

FIGS. 5, 13. Dorsal view, ×100, and internal view to show radial pore canals, ×85. Left valve. Io.2608.

FIGS. 6, 11. Dorsal view, ×100, and external view, ×85, right valve. Io.2609.

FIGS. 7, 8. External and internal views, left valve. Lectotype, IN.43505. ×85.

FIGS. 9, 10. External and internal views, left valve. Io.2610. ×85.

FIG. 12. Muscle scars, left valve. Io.2608. ×340.

Oligocythereis fullonica (Jones & Sherborn) p. 61

FIG. 14. External view, left valve. Io.2624. ×85.

FIG. 15. External view, right valve. Io.2623. ×85.


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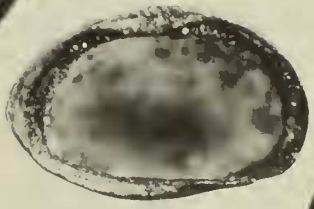
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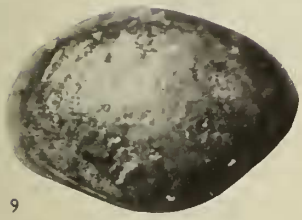
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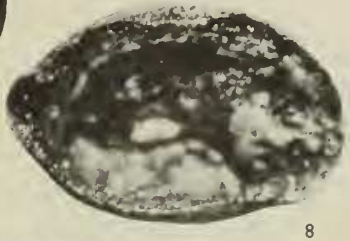
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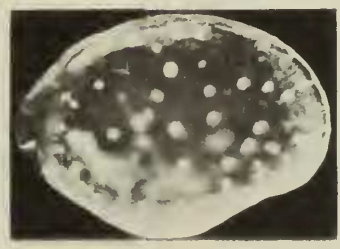

PLATE 22

Platycythere verriculata gen. et sp. nov. p. 62

FIGS. 1–4. Right, left, dorsal and ventral views, male carapace. Holotype, Io.2613. ×85.

FIGS. 5–8. Right, left, ventral and dorsal views, female carapace. Paratype, Io.2621. ×85.

FIG. 9. Internal view, male right valve. Paratype, Io.2615, ×85.

FIG. 10. Dorsal view showing enlarged anterior portion of median hinge bar. Male left valve. Paratype, Io.2616. ×100.

FIG. 11. Left side of juvenile carapace. Paratype, Io.2622, ×85.

FIGS. 12, 13. Muscle scars, ×220, anterior radial pore canals, ×200, male right valve. Paratype, Io.2614.


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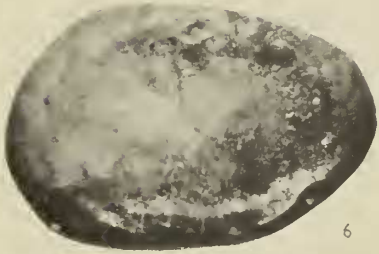
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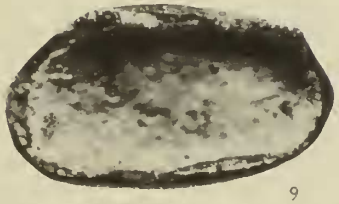
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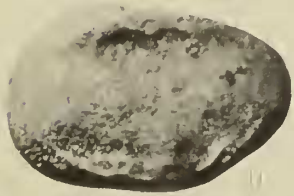
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